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April 16, 2004
277085.20.01.PL

Mr. Gary Riley
Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612

Subject: Draft Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan, Investigation Areas B and C1 Fuel-Oil Pipeline Segments, Lennar Mare Island, Vallejo, California

Dear Mr. Riley:

In accordance with Task C.7 *Completion of Site Characterization of the Nature and Extent of Petroleum Pollution* and Task C.8 *Interim Remedial Action Workplan for Petroleum Pollution* of the California Regional Water Quality Board Order No. R2-2002-0105, we are submitting the Draft Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan, Investigation Areas B and C1 Fuel-Oil Pipeline Segments, Lennar Mare Island, Vallejo, California. An electronic copy of this submittal can be found at the back of this document.

Please submit your comments to my attention at the above address or via e-mail at jmorris1@CH2M.com by May 17, 2004.

If you have any questions regarding this document, please contact me at 510/587-7539.

Sincerely,

CH2M HILL

A handwritten signature in dark ink, appearing to read "Jeffery C. Morris".

Jeffery C. Morris, P.E.

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Draft

Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan, Investigation Areas B and C1 Fuel-oil Pipeline Segments, Lennar Mare Island, Vallejo, California

Prepared for
Regulatory Agencies

April 2004



CH2MHILL

155 Grand Avenue, Suite 1000
Oakland, CA 94612

Executive Summary

This site characterization report, site closure report, and interim remedial action work plan (SCR/SCR/IRA work plan) for fuel-oil pipeline (FOPL) segments in Investigation Areas (IA) B and C1 was prepared in accordance with Tasks C.7 and C.8 of the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB) Order Number R2-2002-0105 (RWQCB 2002). According to the process prescribed by Order Number R2-2002-0105, this SCR/SCR/IRA work plan presents the results of the 2002-2003 FOPL investigation performed in accordance with the *Final Sampling and Analysis Plan for the FOPL* (CH2MHILL 2003a). This SCR/SCR/IRA work plan also presents an evaluation of the results of recent and previous field investigations related to the FOPL to make the determination of which FOPL segments are considered appropriate for permanent closure, according to RWQCB guidance (RWQCB 2003), and which sites require remedial action. This report also presents recommendations for remedial action for the sites for which remedial action is appropriate.

An estimated 51,000 linear feet of FOPL have been installed at Mare Island Naval Shipyard (MINS) over a period of approximately 90 years. Approximately 49,000 feet of FOPL are located within the Eastern Early Transfer Parcel (EETP). The remaining 2,000 feet of FOPL are located outside of the EETP near Mare Island Elementary School and Building 1294. Approximately 1,600 feet of FOPL are located within IA B, and approximately 14,400 feet of FOPL are located within IA C1. The FOPL distribution system was used to transport fuel oil across the former MINS between underground storage tanks (UST) and aboveground storage tanks (AST), buildings, and work areas. The USTs and ASTs were used primarily for oil-fired, steam-driven machinery and to store heating oil for steam-heat boilers. Additionally, FOPL segments extended to the Mare Island Strait for the purpose of conveying fuel oil to ships.

Field investigations have been performed along the FOPL between 1993 and 2003. Analytical data for soil and groundwater samples collected during recent and previous investigations of the FOPL, UST sites, and Installation Restoration Program sites near the FOPL were evaluated relative to RWQCB Tier 1 environmental screening levels (ESL). The Tier 1 ESLs are considered conservative, and the presence of a chemical in soil or groundwater at concentrations below the corresponding ESL can be assumed to pose no significant threat to human health or the environment (RWQCB 2003). Because some environmental and human health concerns considered in determining the Tier 1 ESLs may not be applicable to sites where various release mechanisms or exposure routes are not complete, Tier 2 risk analyses were conducted to provide site-specific Tier 2 screening levels for select FOPL segments. Tier 2 screening levels were developed by adjusting the Tier 1 ESLs to reflect conditions or alternative risk assumptions specific to the site and by considering only the complete exposure pathways. The Tier 2 risk analysis includes an evaluation of the potential ecological risk created by constituents in groundwater.

Four FOPL segments are located at least partially within IA B, and 35 FOPL segments are located at least partially within IA C1. Table ES-1 (located at the end of this executive

summary) presents a summary of the FOPL segments located in IA B and IA C1, including the lengths of removed, flushed, abandoned, and non-located portions of each FOPL segment; the total number of soil and groundwater samples collected at each FOPL segment during recent and previous investigations; and the number of soil and groundwater samples that contained petroleum hydrocarbons, benzene, toluene, ethylbenzene, and xylene compounds, and/or polynuclear aromatic hydrocarbons at concentrations exceeding Tier 1 ESLs. Analytical data that are no longer representative of existing conditions because of previous excavation and/or natural attenuation (as confirmed by 2002 and 2003 verification sampling) are not included in the determination of the number of samples with elevated concentrations of constituents (i.e., above Tier 1 ESLs). Previous releases from 27 FOPL segments in IA B and IA C1 have resulted in constituents in adjacent groundwater and/or soil at concentrations exceeding Tier 1 ESLs. Table ES-1 also presents the constituents of potential concern (COPC), which are the constituents that were detected at concentrations exceeding the corresponding Tier 1 ESL and the maximum concentration detected for the COPCs.

Tier 2 screening levels were developed for 25 FOPL segments in IA C1. Table ES-1 indicates the FOPL segments with COPCs in soil and/or groundwater at concentrations exceeding the Tier 2 screening levels and a conclusion as to whether a remedial action should be performed at the FOPL segment. COPCs were detected in soil and/or groundwater at concentrations exceeding Tier 2 screening levels at 10 FOPL segments. The COPCs with exposure point concentrations that exceed the corresponding Tier 2 screening levels for these 10 FOPL segments are shown in bold in Table ES-1. Interim remedial actions are recommended for 7 of these 10 FOPL segments. Remedial alternatives to address contamination at the three remaining FOPL segments with elevated COPC concentrations (I1/4/B471, I1/6/B473A&B, and I1/6/B693A&B) will be evaluated in a future document in accordance with Task C.10 of RWQCB Order R2-2002-0105 (RWQCB 2002). Interim remedial actions are also recommended for an additional four FOPL segments in IA B and IA C1 on the basis of observations made in the field during the 2002-2003 FOPL investigation. The proposed interim remedial action for these 11 FOPL segments is presented in Table ES-1. In addition to these proposed interim remedial actions, further groundwater monitoring is recommended at one additional FOPL segment (G1/6/WTRF). The results of the proposed interim remedial action and groundwater monitoring for these 12 FOPL segments will be documented in a future implementation report for FOPL segments in IA B and IA C1. Contamination associated with two additional FOPL segments is addressed as part of the remedial action for the Building 811 Area in IA B, as documented in *Draft Site Characterization Report and Interim Remedial Action Work Plan for Building 811 Area in Investigation Area B* (CH2M HILL pending). The results of these actions will be documented in an implementation report for the Building 811 Area.

According to the evaluation presented in this report, 21 FOPL segments are determined to be low-risk sites that are appropriate for permanent closure. The source of potential soil and groundwater contamination at these FOPL segments has been removed and/or remediated. In addition, these segments are not a threat to groundwater or surface water and do not present a significant risk to human health or the environment. Of these 21 FOPL segments, the RWQCB provided approval for closure of five FOPL segments (I1/4/BE3BE8, G1/6/B829A&B, G1/8/7E, G2/X/B637, and I1/4/B477) on the basis of information provided in *Draft Fuel-oil Pipeline Site Identification Technical Memorandum, Mare Island*,

Vallejo, California (CH2M HILL 2002; RWQCB 2004a). The RWQCB has also approved closure of FOPL segment G2/10/7ST on the basis of information provided in *Draft Site Closure Summary Report for Fuel-oil Pipeline Segments D1/4/B678N1, D1/4/B678N2, E2/4/B382, E2/2/B390, E2/3/B388, E2/3/B386, and G1/10/8ST in Investigation Area C2, Mare Island, Vallejo, California* (CH2M HILL 2003b; RWQCB 2004b).

Works Cited

- CH2M HILL. Pending. *Draft Site Characterization Report and Interim Remedial Action Work Plan for Building 811 Area in Investigation Area B, Lennar Mare Island, Vallejo, California*. March.
- _____. 2003a. *Final Sampling and Analysis Plan for the Fuel-oil Pipeline, Mare Island, Vallejo, California*. September 16.
- _____. 2003b. *Draft Site Closure Summary Report for Fuel-oil Pipeline Segments D1/4/B678N1, D1/4/B678N2, E2/4/B382, E2/2/B390, E2/3/B388, E2/3/B386, and G1/10/8ST in Investigation Area C2, Mare Island, Vallejo, California*. April 30.
- _____. 2003c. *Draft Site Characterization and Removal Action Summary Report for Six Underground Storage Tanks in Investigation Area B*. December 9.
- _____. 2002. *Draft Fuel-oil Pipeline Site Identification Technical Memorandum, Mare Island, Vallejo, California*. November 25.

TABLE ES-1
Summary of EETP FOPL Segment Lengths in IA B and IA C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment (Section No.)	Pipeline Status					Soil				Groundwater				Additional Information on Pipeline or Contamination	Interim Remedial Action Proposed ?	Proposed Interim Remedial Action
	Removed (ft)	Flushed (ft)	Abandoned (ft)	Not Located (ft)	Total (ft)	Number of Soil Samples	Number of Samples with Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/kg) ^a	Tier 2 Screening Levels for Soil (Bold when Exceeded by EPC)	Number of Groundwater Samples	Number Samples at Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/L) ^a	Tier 2 Screening Levels for Groundwater (Bold when Exceeded by EPC)			
G1/10/8ST	0	0	0	238	238	8	0			0				Pipeline not located during geophysical survey. Likely removed during installation of parallel FOPL segment G1/8/8ST. RWQCB has concluded that no further action is appropriate (RWQCB 2004a).	No	
G1/8/8ST (3.2)	235	0	0	0	235	4	1	TPH-diesel: 740	TPH-diesel: 10,000	1	0			None.	No	
G1/10/7E, G1/10/BE10, and G1/6/7E (4.2)	1,923	110	60	0	2,093	209	35	TPH-diesel: 30,000 TPH-motor-oil: 13,000 TPH-fuel-oil: 18,000 anthracene: 14 benzo(a)anthracene: 3 benzo(g,h,i)perylene: 10 benzo(a)pyrene: 17 benzo(b)fluoranthene: 19 chrysene: 36 dibenzo(a,h)anthracene: 4 fluoranthene: 170 ideno(1,2,3-c,d)perylene: 9 phenanthrene: 180 pyrene: 170	TPH-diesel: 5,800 TPH-motor-oil: 5,800 TPH-fuel-oil: 5,800 anthracene: 88 benzo(a)anthracene: 13 benzo(g,h,i)perylene: 35 benzo(a)pyrene: 1.3^b benzo(b)fluoranthene: 13 chrysene: 53 dibenzo(a,h)anthracene: 3.8 fluoranthene: 820 ideno(1,2,3-c,d)perylene: 13 phenanthrene: 950 pyrene: 770	50	10	TPH-diesel: 92,000 TPH-motor-oil: 1,500 TPH-fuel-oil: 1,700 benzo(a)pyrene: 0.47 benzo(a)anthracene: 6 chrysene: 0.6 fluoranthene: 14 fluorene: 14	TPH-diesel: 50,000 TPH-motor-oil: 50,000 TPH-fuel-oil: 50,000 benzo(a)pyrene: 50,000 benzo(a)anthracene: 50,000 chrysene: 50,000 fluoranthene: 50,000 fluorene: 50,000	Petroleum hydrocarbons not detected during recent groundwater monitoring events at downgradient monitoring wells.	Yes	Excavate approximately 80 cubic yards of contaminated soil at previous sample locations B121VB006, B121VB008, and BE10GB0100. Collect confirmation soil samples following excavation.
G1/X/BE10 (4.3)	0	0	0	169	169	12	3	TPH-diesel: 4,300 TPH-motor-oil: 3,500	TPH-diesel: 10,000 TPH-motor-oil: 10,000	2	1	TPH-diesel: 850	TPH-diesel: 50,000	Pipeline suspected of being the FOPL was located in an exploratory trench at the southern end of this segment.	Yes	Perform vacuum testing, and flush and cap pipeline.

TABLE ES-1
Summary of EETP FOPL Segment Lengths in IA B and IA C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment (Section No.)	Pipeline Status					Soil				Groundwater				Additional Information on Pipeline or Contamination	Interim Remedial Action Proposed ?	Proposed Interim Remedial Action
	Removed (ft)	Flushed (ft)	Abandoned (ft)	Not Located (ft)	Total (ft)	Number of Soil Samples	Number of Samples with Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/kg) ^a	Tier 2 Screening Levels for Soil (Bold when Exceeded by EPC)	Number of Groundwater Samples	Number Samples at Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/L) ^a	Tier 2 Screening Levels for Groundwater (Bold when Exceeded by EPC)			
G1/2/B207 (4.6)	88	0	0	0	88	9	2	TPH-fuel-oil: 6,400 TPH-motor-oil: 18,000	TPH-fuel-oil: 10,000 TPH-motor-oil: 10,000^c	2	2	TPH-motor-oil: 780	TPH-motor-oil: 50,000	None.	Yes	Excavate approximately 30 cubic yards of contaminated soil at former sample location B204GB004. Collect confirmation soil samples following excavation.
G1/X/B207B (3.11)	0	0	0	25	25	7	0			2	1	TPH-motor-oil: 680	N/A	Pipeline not located during geophysical survey and exploratory trenching. Groundwater contamination is associated with releases from FOPL segment G1/2/B207 and is included in the Tier 2 risk analysis for that segment.	No	
H1/2/B207B (3.14)	201	0	0	0	201	11	2	TPH-diesel: 730	TPH-diesel: 10,000	4	3	TPH-diesel: 2,200 TPH-motor-oil: 1,300	TPH-diesel: 50,000 TPH-motor-oil: 50,000	Soil and groundwater contamination is associated with parallel FOPL segment H1/X/B207S.	No	
G1/4/3ST (3.9)	451	162	0	0	613	36	14	TPH-diesel: 11,000 TPH-fuel-oil: 7,800 TPH-motor-oil: 8,200	TPH-diesel: 10,000 TPH-fuel-oil: 10,000 TPH-motor-oil: 10,000	6	3	TPH-diesel: 2,600 TPH-motor-oil: 1,200	TPH-diesel: 50,000 TPH-motor-oil: 50,000	None.	No	

TABLE ES-1
Summary of EETP FOPL Segment Lengths in IA B and IA C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment (Section No.)	Pipeline Status					Soil				Groundwater				Additional Information on Pipeline or Contamination	Interim Remedial Action Proposed ?	Proposed Interim Remedial Action
	Removed (ft)	Flushed (ft)	Abandoned (ft)	Not Located (ft)	Total (ft)	Number of Soil Samples	Number of Samples with Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/kg) ^a	Tier 2 Screening Levels for Soil (Bold when Exceeded by EPC)	Number of Groundwater Samples	Number Samples at Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/L) ^a	Tier 2 Screening Levels for Groundwater (Bold when Exceeded by EPC)			
G2/4/3ST (4.1)	871	0	0	0	871	35	12	TPH-diesel: 23,000 TPH-motor-oil: 4,000	N/A	3	1	TPH-diesel: 14,000 TPH-motor-oil: 7,500	N/A	A pipeline suspected of being FOPL segment G2/4/3ST was identified in the utility corridor south of Building 637.	Yes	This FOPL segment and soil contamination in the vicinity of the FOPL is addressed in <i>Draft Site Characterization Report and Interim Remedial Action Work Plan for Building 811 Area in Investigation Area B</i> (CH2M HILL pending).
G1/4/BE3BE8 (4.5)	754	0	0	0	754	7	2	TPH-diesel: 2,200 TPH-fuel-oil: 1,400 acenaphthene: 100 anthracene: 82 benzo(a)anthracene:24 chrysene: 24 fluoranthene: 160 fluorene: 96 naphthalene: 33 pyrene: 120 benzo(a)pyrene: 0.18	TPH-diesel: 10,000 TPH-fuel-oil: 10,000 acenaphthene: 163 anthracene: 88 benzo(a)anthracene:13^b chrysene: 13^b fluoranthene: 1,246 fluorene: 160 naphthalene: 37 pyrene: 768 benzo(a)pyrene: 1.3	1	0			None.	Yes	Excavate approximately 40 cubic yards of contaminated soil at FOPLBE3BE8GB0 107A. Collect confirmation soil samples following excavation.
H1/4/BE3BE8 (3.8)	1,196	152	0	0	1,348	7	0			0				None.	No	
I1/4/BE3BE8 (3.19)	0	2,882	0	0	2,882	6	0			1	0			FOPL segment has been flushed and hangs above Mare Island Strait. RWQCB has concluded that no further action is appropriate (RWQCB 2004b).	No	
G1/6/B829A&B (3.3)	94	0	0	0	94	8	0			0				RWQCB has concluded that no further action is appropriate (RWQCB 2004b).	No	

TABLE ES-1
Summary of EETP FOPL Segment Lengths in IA B and IA C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment (Section No.)	Pipeline Status					Soil				Groundwater				Additional Information on Pipeline or Contamination	Interim Remedial Action Proposed ?	Proposed Interim Remedial Action
	Removed (ft)	Flushed (ft)	Abandoned (ft)	Not Located (ft)	Total (ft)	Number of Soil Samples	Number of Samples with Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/kg) ^a	Tier 2 Screening Levels for Soil (Bold when Exceeded by EPC)	Number of Groundwater Samples	Number Samples at Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/L) ^a	Tier 2 Screening Levels for Groundwater (Bold when Exceeded by EPC)			
G1/6/B971 (4.4)	0	0	0	175	175	26	14	TPH-diesel: 33,000 TPH-fuel-oil: 6,100 TPH-motor-oil: 11,000 anthracene: 24 fluorene: 14	TPH-diesel: 10,000^c TPH-fuel-oil: 10,000 TPH-motor-oil: 10,000 anthracene: 88 fluorene: 160	1	1	TPH-diesel: 1,000 TPH-motor-oil: 900	TPH-diesel: 50,000 TPH-motor-oil: 50,000	Pipeline not located during exploratory trenching.	Yes	Excavate approximately 330 cubic yards of contaminated soil at FOPLB971SS0100. Collect confirmation soil samples following excavation.
G1/X/B493 (3.5)	0	0	0	860	860	21	5	TPH-diesel: 7,400 TPH-motor-oil: 9,500	TPH-diesel: 10,000 TPH-motor-oil: 10,000	2	1	TPH-diesel: 710 TPH-motor-oil: 730	TPH-diesel: 50,000 TPH-motor-oil: 50,000	Pipeline not located during geophysical survey or during exploratory trenching.	No	
G1/6/WTRF (3.6)	1,096	125	0	0	1,221	68	5	TPH-diesel: 2,600 TPH-fuel-oil: 2,300	TPH-diesel: 10,000 TPH-fuel-oil: 10,000	29	3	TPH-gasoline: 2,900 TPH-diesel: 2,500 TPH-motor-oil: 3,400	TPH-gasoline: 50,000 TPH-diesel: 50,000 TPH-motor-oil: 50,000	Groundwater will be sampled at 15W17 for a minimum of 4 quarters to determine if previous releases from this segment are resulting in an impact to Mare Island Strait.	No	
G1/8/7E (3.2)	96	55	0	0	151	4	0			1	1	TPH-diesel: 100,000 TPH-motor-oil: 9,600	N/A	Groundwater sample was collected in 1993. A sample collected approximately 10 feet downgradient of FOPL in 2002 contained TPH less than Tier 1 ESLs. RWQCB has concluded that no further action is appropriate (RWQCB 2004b).	No	
G1/X/B121 (3.4)	120	0	0	0	120	10	2	TPH-gasoline: 780 TPH-diesel: 8,600 TPH-motor-oil: 3,400	TPH-gasoline: 5,000 TPH-diesel: 9,667 TPH-motor-oil: 9,667	4	2	TPH-diesel: 50,000 TPH-motor-oil: 41,000	TPH-diesel: 50,000 TPH-motor-oil: 50,000	Petroleum hydrocarbons not detected in 2002 grab groundwater sample, indicating that petroleum hydrocarbons are no longer present.	No	
G1/X/B207S (3.10)	215	0	0	25	240	3	2	TPH-fuel-oil: 6,000	TPH-fuel-oil: 10,000	0				None.	No	

TABLE ES-1
Summary of EETP FOPL Segment Lengths in IA B and IA C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment (Section No.)	Pipeline Status					Soil				Groundwater				Additional Information on Pipeline or Contamination	Interim Remedial Action Proposed ?	Proposed Interim Remedial Action
	Removed (ft)	Flushed (ft)	Abandoned (ft)	Not Located (ft)	Total (ft)	Number of Soil Samples	Number of Samples with Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/kg) ^a	Tier 2 Screening Levels for Soil (Bold when Exceeded by EPC)	Number of Groundwater Samples	Number Samples at Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/L) ^a	Tier 2 Screening Levels for Groundwater (Bold when Exceeded by EPC)			
H1/X/B207S (3.12)	201	0	0	0	201	18	9	TPH-diesel: 4,200 TPH-fuel-oil: 11,000 TPH-motor-oil: 3,300	TPH-diesel: 10,000 TPH-fuel-oil: 10,000 TPH-motor-oil: 10,000	6	5	TPH-diesel: 4,000 TPH-motor-oil: 2,200	TPH-diesel: 10,000 TPH-motor-oil: 10,000	None.	No	
G1/X/BE9 (3.7)	0	0	0	64	64	3	0			0				Exploratory trench could not be advanced because of presence of live electrical lines.	No	
G2/2.5/3ST (4.1)	0	0	0	284	284	15	7	TPH-diesel: 3,300 TPH-motor-oil: 2,600 benzo(a)pyrene: 0.049	N/A	0				A pipeline suspected of being FOPL segment G2/2.5/3ST was identified in the utility corridor south of Building 637.	Yes	This FOPL segment and soil contamination in the vicinity of the FOPL is addressed in <i>Draft Site Characterization Report and Interim Remedial Action Work Plan for Building 811 Area in Investigation Area B</i> (CH2M HILL pending).
G2/X/B637 (3.1)	145	0	0	0	145	7	1	TPH-diesel: 1,900	N/A	2	1	TPH-diesel: 1,600	N/A	Tier 2 evaluation for USTs 637-1 and 637-2 (CH2M HILL 2003c) applies to this FOPL segment. RWQCB has concluded that No Further Action is appropriate for this FOPL segment (RWQCB 2004b).	No	
H1/2.5/CALIF (3.16)	383	0	0	0	383	10	1	TPH-fuel-oil: 3,800	TPH-fuel-oil: 10,000	1	1	TPH-diesel: 1,100 TPH-motor-oil: 1,500	TPH-diesel: 50,000 TPH-motor-oil: 50,000	None.	No	
H1/2/B111 (3.13)	318	179	0	0	497	32	9	TPH-diesel: 18,000 TPH-motor-oil: 15,000 benzo(a)pyrene: 0.55	TPH-diesel: 10,000 TPH-motor-oil: 10,000 benzo(a)pyrene: 1.3	3	3	TPH-diesel: 3,400 TPH-motor-oil: 4,600	TPH-diesel: 50,000 TPH-motor-oil: 50,000	None.	No	

TABLE ES-1
Summary of EETP FOPL Segment Lengths in IA B and IA C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment (Section No.)	Pipeline Status					Soil				Groundwater				Additional Information on Pipeline or Contamination	Interim Remedial Action Proposed ?	Proposed Interim Remedial Action
	Removed (ft)	Flushed (ft)	Abandoned (ft)	Not Located (ft)	Total (ft)	Number of Soil Samples	Number of Samples with Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/kg) ^a	Tier 2 Screening Levels for Soil (Bold when Exceeded by EPC)	Number of Groundwater Samples	Number Samples at Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/L) ^a	Tier 2 Screening Levels for Groundwater (Bold when Exceeded by EPC)			
H1/2/B207A (3.15)	100	0	0	0	100	18	8	TPH-diesel: 3,100 TPH-fuel-oil: 1,900 TPH-motor-oil: 3,000	TPH-diesel: 10,000 TPH-fuel-oil: 10,000 TPH-motor-oil: 10,000	4	2	TPH-diesel: 7,800 TPH-motor-oil: 5,700 Chrysene: 0.94 Fluorene: 5.3	TPH-diesel: 50,000 TPH-motor-oil: 50,000 Chrysene: 50,000 Fluorene: 50,000	None.	No	
H1/2/B271 (3.18)	0	0	0	117	117	7	6	TPH-diesel: 2,000 TPH-fuel: 7,300 TPH-motor-oil: 1,500	TPH-diesel: 10,000 TPH-fuel: 10,000 TPH-motor-oil: 10,000	1	1	TPH-diesel: 5,800 TPH-motor-oil: 2,000	TPH-diesel: 50,000 TPH-motor-oil: 50,000	Pipeline not located during previous exploratory trenching.	No	
H1/6/B85 (4.7)	0	0	0	300	300	24	8	TPH-diesel: 16,000 TPH-motor-oil: 10,000	TPH-diesel: 10,000 TPH-motor-oil: 10,000	4	4	TPH-diesel: 5,800 TPH-motor-oil: 3,100	TPH-diesel: 50,000 TPH-motor-oil: 50,000	Pipeline suspected of being the FOPL located during exploratory trenching.	Yes	Trench at two locations along the FOPL and perform vacuum testing.
H1/X/B87 (3.14)	0	0	0	52	52	2	0			1	0			Pipeline no longer present.	No	
H1/2/B89 (4.8)	0	0	0	266	266	12	3	TPH-diesel: 9,400 TPH-motor-oil: 2,200 benzo(a)pyrene: 0.34	TPH-diesel: 10,000 TPH-motor-oil: 10,000 benzo(a)pyrene: 1.3	5	4	TPH-diesel: 51,000 TPH-motor-oil: 31,000 chrysene: 0.62	TPH-diesel: 50,000 TPH-motor-oil: 50,000 chrysene: 0.35	Pipeline not located during exploratory trenching. Separate-phase hydrocarbons observed in grab groundwater sample from FOPLB89GB0100C.	Yes	Install groundwater monitoring wells downgradient of FOPL segment H1/2/B89 and at location of FOPLB89GB0100C and monitor quarterly.
H1/2/B85S (3.17)	0	0	0	254	254	16	6	TPH-diesel: 14,000 TPH-motor-oil: 11,000 benzo(a)pyrene: 0.74	TPH-diesel: 10,000 TPH-motor-oil: 10,000 benzo(a)pyrene: 1.3	4	1	TPH-diesel: 1,600 TPH-motor-oil: 1,100	TPH-diesel: 50,000 TPH-motor-oil: 50,000	Pipeline not located during exploratory trenching.	No	

TABLE ES-1
Summary of EETP FOPL Segment Lengths in IA B and IA C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment (Section No.)	Pipeline Status					Soil				Groundwater				Additional Information on Pipeline or Contamination	Interim Remedial Action Proposed ?	Proposed Interim Remedial Action
	Removed (ft)	Flushed (ft)	Abandoned (ft)	Not Located (ft)	Total (ft)	Number of Soil Samples	Number of Samples with Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/kg) ^a	Tier 2 Screening Levels for Soil (Bold when Exceeded by EPC)	Number of Groundwater Samples	Number Samples at Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/L) ^a	Tier 2 Screening Levels for Groundwater (Bold when Exceeded by EPC)			
I1/4/B477 (3.20)	155	15	10	0	180	7	0			7	1	TPH-diesel: 2,000	N/A	The RWQCB has concluded that no further action is appropriate (RWQCB 2004b) Contamination in groundwater sample is associated with releases from pre-treatment facility T-2 located upgradient of the FOPL at Building 985. This contamination will be addressed in the remedial investigation report for IA C1.	No	
I1/6/B473A&B, I1/6/B693A&B, and I1/4/B471 (4.10)	720	242	0	102	1,064	94	17	TPH-diesel: 16,000 TPH-gasoline: 1,000 benzo(a)pyrene: 0.75 napthalene: 11	TPH-diesel: 10,000 TPH-gasoline: 5,000 benzo(a)pyrene: 1.3 napthalene: 42.5	74	15	TPH-diesel: 570,000 TPH-gasoline: 4,900 TPH-motor-oil: 8,000 anthracene: 2.4 benzo(a) anthracene: 19 benzo(a)pyrene: 21 benzo(b) fluoranthene: 23 benzo(g,h,i) perylene: 6 benzo(k) fluoranthene: 22 chrysene: 14 dibenzo(a,h) anthracene: 3 fluoranthene: 110 fluorene: 13 ideno(1,2,3-c,d)pyrene: 7 napthalene: 40 phenanthrene: 35 pyrene: 26 xylene: 53	TPH-diesel: 50,000 TPH-gasoline: 50,000 TPH-motor-oil: 50,000 anthracene: 50,000 benzo(a) anthracene: 50,000 benzo(a) pyrene: 50,000 benzo(b) fluoranthene: 50,000 benzo(g,h,i) perylene: 50,000 benzo(k) fluoranthene: 50,000 chrysene: 50,000 dibenzo(a,h) anthracene: 50,000 fluoranthene: 50,000 fluorene: 50,000	Previous releases from these FOPL segments have likely resulted in the separate-phase hydrocarbons observed in the area (IR03). Remedial alternatives to address separate-phase hydrocarbons and elevated petroleum hydrocarbon concentrations in groundwater will be evaluated in a future document in accordance with Task C.10 of RWQCB Order R2-2002-0105 (RWQCB 2002). FOPL segment I1/6/B473A&B was likely located during exploratory trenching performed in 2003.	Yes	Perform vacuum testing on pipeline suspected of being FOPL segment I1/6/B473A&B.

TABLE ES-1
Summary of EETP FOPL Segment Lengths in IA B and IA C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

Pipeline Status						Soil				Groundwater						
FOPL Segment (Section No.)	Removed (ft)	Flushed (ft)	Abandoned (ft)	Not Located (ft)	Total (ft)	Number of Soil Samples	Number of Samples with Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/kg) ^a	Tier 2 Screening Levels for Soil (Bold when Exceeded by EPC)	Number of Groundwater Samples	Number Samples at Concentrations >Tier 1 ESLs ^a	Maximum Concentrations of Constituents of Concern (mg/L) ^a	Tier 2 Screening Levels for Groundwater (Bold when Exceeded by EPC)	Additional Information on Pipeline or Contamination	Interim Remedial Action Proposed ?	Proposed Interim Remedial Action
													ideno(1,2,3–c,d)pyrene: 50,000 naphthalene: 50,000 phenanthrene: 50,000 pyrene: 50,000 xylene: 50,000			
I1/1.5/B289 (4.9)	0	0	0	74	74	4	0			0				Pipeline suspected of being FOPL identified during exploratory trenching.	Yes	Cut utilities suspected of being FOPL to confirm utility type. Perform vacuum testing if utility is confirmed to be FOPL.
TOTAL FOPL Segment Lengths	9,362	3,922	70	3,005	16,359											

^aOnly analytical data for soil samples representative of existing conditions are included in this evaluation. Soil analytical data that are no longer representative of existing conditions because of previous excavation and/or natural attenuation (as confirmed through 2002 and 2003 confirmation sampling) are excluded from this evaluation. Groundwater analytical data collected prior to 1997 are also excluded at groundwater monitoring wells for which more recent data are available.

^bTier 2 screening level is dictated by the human health risk established by direct exposure to COPCs (RWQCB 2003, Table K-2 (0 to 10 feet bgs) or Table K-3 (>10 feet bgs) multiplied by 10 (using risk of 10⁻⁵ instead of 10⁻⁶ for carcinogenic COPCs)).

^cTier 2 screening level dictated by ceiling value.

Notes:

EPC = exposure point concentration

µg/L = micrograms per liter

mg/kg = milligrams per kilogram

N/A = not applicable

TPH = total petroleum hydrocarbon

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Acronyms and Abbreviations

°F	degrees Fahrenheit
ABM	abrasive blast material
AST	aboveground storage tank
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
COC	constituent of concern
COPC	constituent of potential concern
DOM	domestic pump station
EPC	exposure point concentration
EETP	Eastern Early Transfer Parcel
ERA	ecological risk assessment
ESL	environmental screening level
FDP	fuel distribution pipeline
ft/ft	foot per foot
FOPL	fuel-oil pipeline
GPR	ground-penetrating radar
IA	Investigation Area
IR	Installation Restoration
IRA	interim remedial action
IRP	Installation Restoration Program
IWTP	industrial wastewater treatment plant
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
MINS	Mare Island Naval Shipyard
msl	mean sea level
MTBE	methyl tributyl ethylene

Navy	Unites States Department of the Navy
OWS	oil/water separator
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
PID	photoionization detector
ppm	parts per million
PVC	polyvinyl chloride
RRU	Resin Regeneration Unit
RWQCB	California Regional Water Quality Control Board, San Francisco Bay Region
SAP	sampling and analysis plan
SCR/SCR/IRA work plan	site characterization report, site closure report, and interim remedial action work plan
SWRCB	State Water Resources Control Board
TPH	total petroleum hydrocarbon
TRPH	total recoverable petroleum hydrocarbon
TtEMI	Tetra Tech Environmental Management, Inc.
UCL	upper confidence limit
UST	underground storage tank
VOC	volatile organic compound

1.0 Introduction

This section presents the document objectives, document organization, and describes how this site characterization report, site closure report, interim remedial action work plan (SCR/SCR/IRA work plan) for the fuel-oil pipeline (FOPL) segments in Investigation Areas (IA) B and C1 is integrated with the sitewide documents. The approach to the evaluation of FOPL segments in this SCR/SCR/IRA work plan is also presented.

1.1 Document Objectives

CH2M HILL prepared this SCR/SCR/IRA work plan in accordance with Task C.7 and Task C.8 of the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB) Order Number R2-2002-0105 (RWQCB 2002). Based on the process prescribed by the Order, this SCR/SCR/IRA work plan presents the results of the 2002-2003 FOPL investigation, including the determination of which FOPL segments are considered appropriate for permanent closure, based on RWQCB guidance (RWQCB 2003), and which sites require additional remedial action. A plan for implementation of proposed remedial action is provided for those FOPL segments that require remedial action. A separate SCR/SCR/IRA work plan will be developed for IA C2. The *Draft Site Characterization Report/Interim Remedial Action Work Plan, Investigation Area D1 Fuel-oil Pipeline Segments* (CH2M HILL 2003d) was submitted to regulatory agencies in October 2003. One FOPL segment that is located partially in IA C1 (FOPL segment G1/10/8ST) was included in the *Draft Site Closure Summary Report for Fuel-oil Pipeline Segments D1/4/B678N1, D1/4/B678N2, E2/4/B382, E2/2/B390, E2/3/B388, E2/3/B386, and G1/10/8ST in Investigation Area C2, Mare Island, Vallejo, California* (CH2M HILL 2003b), which was submitted to regulatory agencies in April 2003. The RWQCB provided approval for closure of this FOPL segment in January 2004 (RWQCB 2004b); this FOPL segment is consequently excluded from this site characterization report.

The objectives of this document are to:

- Present and evaluate soil and groundwater data from previous FOPL investigations.
- Present and evaluate the site characterization work completed in 2002 and 2003.
- Request no further action and permanent closure for 21 FOPL segments in IA B and IA C1.
- Propose additional field investigation and/or remediation at 14 FOPL segments in IA C1.
- Identify FOPL segments in IA B for which remedial action is being addressed with the Building 811 Area.

1.2 Document Organization

This SCR/SCR/IRA work plan is organized into the following sections:

- **Section 1.0** presents the scope, objectives, structure of this report, and approach to site characterization.
- **Section 2.0** provides background information for the Mare Island Naval Shipyard (MINS), FOPL, IA B, and IA C1.
- **Section 3.0** contains site background information, summaries of the 2002-2003 FOPL investigation, and conclusions for FOPL segments in IAs B and C1 for which no further action is appropriate.
- **Section 4.0** contains site background information, summaries of the 2002-2003 FOPL investigation, a recommendation for further investigative and/or remedial action at the FOPL segments not included in Section 3.0, and a work plan for implementation of investigative and/or remedial action at these FOPL segments.
- **Section 5.0** presents a list of references used in the preparation of this SCR/SCR/IRA work plan.

1.3 Integration of Sitewide Documents

CH2M HILL conducted the 2002-2003 site characterization work in accordance with the *Final Sampling and Analysis Plan for the Fuel-oil Pipeline* (CH2M HILL 2003a). The specific sampling methodology, documentation, shipment, and quality control specifications that were used for the implementation of the sampling and analysis plan (SAP) to collect the information discussed in this report can be found in the *Final Quality Assurance Project Plan* (CH2M HILL 2001) or, for more specialized issues, in the appendices of the *Draft Sampling and Analysis Plan for the Fuel-oil Pipeline* (CH2M HILL 2002b). This SCR/SCR/IRA work plan will be implemented consistent with the field procedures identified in Section 3.0 of the *Final Interim Removal Action Work Plan for Industrial Wastewater Pump Stations 1, 12, 6, IR01, IR19, Building 461, and Building 690* (CH2M HILL 2003e). This previous work plan identifies the requirements for site security and access, traffic controls, permits and notifications, subsurface utility surveys, health and safety, and nuisance monitoring and provides guidelines for soil stockpile management, backfill and compaction, wastewater storage, stormwater management, site restoration, and waste transportation and disposal.

1.4 Approach to Site Characterization of FOPL Segments

CH2M HILL submitted the *Draft Sampling and Analysis Plan for the Fuel-oil Pipeline* in July 2002. Based on regulatory comments to this report, a revised field work approach was developed in collaboration with regulatory agencies. CH2M HILL submitted a final SAP to agencies in September 2003 that summarized the revised field work approach. The SAP was implemented during May through October 2003. A geophysical survey and pilot test were performed prior to this period (in October 2002 and January 2003, respectively) in preparation for implementation of the SAP.

The objectives of the field investigation identified in the final SAP were achieved during implementation of the SAP. The field investigation included both a limited investigation and additional site characterization activities when necessary. Soil samples were collected to supplement the existing data set to ensure that analytical data existed for soil at intervals of approximately 50 feet along removed, abandoned, and non-located FOPL segments in residential areas; intervals of 100 feet along removed, abandoned, and non-located FOPL segments in non-residential areas; and intervals of 200 feet along flushed FOPL segments in both residential and non-residential areas. Soil samples were also collected to confirm the presence of contamination detected during previous investigations. Borings were advanced downgradient of the FOPL for soil and groundwater sample collection when analytical data indicated that a release had occurred from the FOPL and also as directed by regulatory agencies. Approximately 370 borings were advanced within the Eastern Early Transfer Parcel (EETP) during the 2002-2003 FOPL investigation, four of which were completed as groundwater monitoring wells. In addition, 32 exploratory trenches were advanced in an attempt to locate previously non-located FOPL segments.

This report documents the results of this field investigation as it pertains to IAs B and C1. Appendices A, B, and C present the analytical data, 2003 lithologic logs, and results of the geophysical survey for FOPL segments in IAs B and C1, respectively.

1.4.1 Tier 1 and Tier 2 Screening Levels

The constituents that are present at FOPL segments in IAs B and C1 include total petroleum hydrocarbons (TPH) fractions (TPH-diesel, TPH-fuel-oil, and TPH-motor-oil); benzene, toluene, ethylbenzene, and xylene (BTEX) compounds; and polynuclear aromatic hydrocarbons (PAHs). The soil and groundwater screening levels selected for TPH fractions, BTEX, and PAHs are the RWQCB Tier 1 environmental screening levels (ESLs) (RWQCB 2003). A Tier 1 ESL has not been established for TPH-fuel-oil. Since the carbon range that comprises TPH-fuel-oil is a combination of the carbon ranges that comprise TPH-diesel and TPH-motor-oil, the Tier 1 ESLs for TPH-diesel are used for comparison to TPH-fuel-oil concentrations to be conservative. The Tier 1 ESLs are considered conservative and the presence of a chemical in soil or groundwater at concentrations below the corresponding ESL can be assumed to not pose a significant threat to human health or the environment (RWQCB 2003).

The Tier 1 ESLs are applied based on the location of the impacted soil (i.e., contamination is located less than or equal to 10 feet below ground surface [bgs] or greater than 10 feet bgs) and the beneficial use of the impacted or potentially impacted groundwater at the site (i.e., whether the threatened groundwater is a current or potential source of drinking water). The ESLs for soil less than 10 feet are more conservative, and these values are used for comparison purposes in this document. The Tier 1 ESLs for shallow soil (less than 10 feet bgs) and subsurface soil (greater than 10 feet bgs) are presented in Tables 1.4-1 and 1.4-2. (All tables are presented at the end of Section 1.0.) For groundwater, it is assumed that the beneficial use of the groundwater does not include a current or potential source of drinking water (CH2M HILL 2003f). The ESLs are also selected based on the anticipated future use of the property (i.e., residential vs. industrial/commercial/educational).

Since some environmental and human health concerns considered in determining the Tier 1 ESLs may not be applicable to sites where various release mechanisms or exposure routes

are not complete, Tier 2 risk analyses were conducted to provide site-specific Tier 2 screening levels for select FOPL segments. Tier 2 screening levels were developed by adjusting the Tier 1 ESLs to reflect conditions or alternative risk assumptions specific to the site and by considering only complete exposure pathways. Appendix D was developed to evaluate which contamination concerns have potentially complete release mechanisms and exposure routes. The following questions are addressed in Appendix D to derive the Tier 2 screening levels for individual FOPL segments:

1. Could contamination in soil and/or groundwater present odor problems (Odor/Nuisance)?
2. Could indoor air be impacted by volatile organic compounds (VOCs) in soil and/or groundwater (Indoor Air Impacts)?
3. Could contamination in groundwater impact surface water bodies (Aquatic Life Protection)?
4. Is general groundwater resource degradation a concern (Upper Concentration Limit)?
5. Is there ecological habitat at the site (Urban Area Toxicity Criteria)?
6. How many non-carcinogenic constituents of concern (COCs) in soil are industrial workers or construction workers potentially in contact with (Direct Exposure)?
7. Will contamination in soil impact groundwater (Groundwater Protection from Soil Leaching)?
8. What are the ceiling values for contamination in soil (Ceiling Values)?

Tier 2 risk analyses were performed for FOPL segments G1/X/B121, G1/X/B207S, G1/X/BE10, G1/2/B207, G1/X/B493, G1/6/B971, G1/6/7E, G1/10/7E, G1/10/BE10, G1/6/WTRF, G1/8/8ST, H1/X/B207S, H1/2/B207B, H1/2/B207A, H1/2.5/CALIF, G1/4/3ST, G1/4/BE3BE8, H1/2/B111, H1/2/B271, H1/2/B85S, H1/2/B89, H1/6/B85, I1/6/B693A&B, I1/6/B473A&B, and I1/4/B471, which are each located in IA C1. The Tier 2 screening levels that were developed for these segments are provided in Tables 1.4-3 and 1.4-4 for soil and groundwater, respectively. A Tier 2 risk analysis was not performed for the FOPL segments located in IA B.

The Tier 2 risk analysis presented in Appendix D includes an evaluation of the potential risk to ecological life. A baseline ecological risk assessment (ERA) was performed for 11 FOPL segments located within 250 feet of Mare Island Strait. Of the 15 FOPL segments located within 250 feet of the Strait in IA C1, groundwater at 11 FOPL segments contains constituents of potential concern (COPCs) at concentrations exceeding Tier 1 ESLs. These 11 FOPL segments are included in the Baseline ERA because the migration pathway for contaminants in groundwater discharging to the Strait is potentially complete.

1.4.2 Degradation of Groundwater Assessment

An evaluation was performed to assess whether contamination associated with previous releases from FOPL segments has degraded the waters of the State of California as per State Water Resource Control Board (SWRCB) Resolution No. 68-16 and SWRCB Resolution No. 92-49. The RWQCB has stated that groundwater has not been degraded if downgradient

wells have concentrations of constituents below their respective ambient water standards. If downgradient wells have concentrations of constituents above their respective ambient water standards, then a determination of whether the source and any secondary sources have been removed needs to be completed. Any ongoing sources that are impacting groundwater need to be addressed prior to or, in conjunction with, the groundwater assessment. If the upgradient sources have been removed and there is still groundwater above ambient water standards, then a feasibility study needs to be completed to determine the most technologically and economically feasible remedial alternative for the groundwater (Morris 2003).

This evaluation was performed for FOPL segments located in IA B and IA C1 based on site-specific information. FOPL segments that are located more than 250 feet from the Strait are not expected to impact surface water in Mare Island Strait, as presented below, and are evaluated together. Similarly, FOPL segments that are located within 250 feet of the Strait with constituent concentrations below Tier 1 ESLs in downgradient groundwater samples are not expected to impact Mare Island Strait and are evaluated together. Finally, FOPL segments that are located within 250 feet of the Strait with elevated COPC concentrations in downgradient groundwater samples are evaluated on a site-by-site basis.

1.4.2.1 FOPL Segments Located More than 250 Feet from Mare Island Strait

Twenty-one FOPL segments located in IA B and IA C1 are located more than 250 feet from Mare Island Strait. At sites where a preferential flow pathway to a surface-water body does not exist, biodegradation will stabilize a hydrocarbon plume within 250 feet of the source, in most cases. The plume also will likely remediate itself through natural biodegradation (RWQCB 1996). Gravity will cause fuel hydrocarbons to spread until the fluid no longer holds together as a single continuous phase but becomes isolated globules. At that point, TPH becomes largely immobile under the usual subsurface-pressure conditions and can migrate farther only in water (according to its solubility) or in the gas phase of the unsaturated zone (Rice et al. 1995). In general, TPH plume lengths change slowly and tend to stabilize at relatively short distances from the source (Rice et al. 1995). Reviews of historical data have shown that plumes of TPH-gasoline did not extend beyond 200 feet in 90 percent of cases, and plumes of benzene extended no more than about 250 feet in 90 percent of cases (Rice et al. 1995).

Because of the immobility and highly biodegradable nature of TPH and related compounds, an impact to surface water from sites located more than 250 feet from a surface-water body is not likely to occur. Therefore, the 21 FOPL segments located more than 250 feet from the Strait (G2/X/B637, G2/4/3ST, G2/2.5/3ST, G1/8/8ST, G1/8/7E, G1/6/B829A&B, G1/X/B121, G1/X/B493, G1/4/3ST, G1/2/B207, G1/X/B207S, G1/X/B207B, H1/2/B207B, H1/X/B207S, H1/2/B111, H1/X/B87, H1/2/B207A, H1/2.5/CALIF, H1/6/B85, H1/2/B271, and I1/1.5/B289) are not expected to impact Mare Island Strait. No further evaluation is warranted to assess the potential for degradation of surface water as a result of previous releases from these 21 FOPL segments.

1.4.2.2 FOPL Segments with Low Constituent Concentrations in Downgradient Groundwater Samples

Constituents were detected at low concentrations (below Tier 1 ESLs) in groundwater samples collected downgradient of FOPL segments G1/6/7E, G1/10/7E, G1/10/BE10, G1/X/BE10, G1/6/B971, G1/4/BE3BE8, H1/2/B85S, I1/4/BE3BE8, and I1/4/B477, which are each located within 250 feet of Mare Island Strait. Data collected during 2003 from monitoring wells positioned downgradient of FOPL segments G1/6/7E, G1/10/7E, G1/10/BE10, G1/X/BE10, G1/6/B971, and I1/4/B477 indicate that potential historical releases from these FOPL segments are not resulting in an impact to surface water in Mare Island Strait. Grab groundwater samples collected downgradient of FOPL segments G1/4/BE3BE8, H1/2/B85S, and I1/4/BE3BE8 in 1998 and 2003 indicate that potential historical releases from these segments are also not resulting in an impact to surface water in the Strait. Although groundwater samples have not been collected downgradient of FOPL segments G1/X/BE9 and H1/4/BE3BE8, analytical data for soil samples collected along these FOPL segments indicate that former use of these segments has not resulted in a release to the subsurface, suggesting that these FOPL segments are also not impacting Mare Island Strait. No further evaluation is warranted to assess the potential for degradation of surface water as a result of previous releases from these 11 FOPL segments.

1.4.2.3 FOPL Segments with Elevated COPC Concentrations at the Strait

Elevated concentrations of COPCs (above Tier 1 ESLs) have been detected in groundwater samples collected along or downgradient of five FOPL segments (G1/6/WTRF, H1/2/B89, I1/6/B473A&B, I1/6/B693A&B, and I1/4/B471). These concentrations do not meet the RWQCB criteria for making the determination that groundwater has not been degraded. Consequently, the potential for impact to groundwater and surface water in Mare Island Strait from each of these FOPL segments is evaluated in Sections 3.6.4.2, 4.8.4.2, and 4.10.4.2.

1.4.3 Petroleum Hydrocarbon Fractions

The TPH fractions associated with the FOPL have been given various designations during previous investigations. For the purpose of presentation and discussion in this report, historical designations for the various petroleum hydrocarbon ranges are grouped as TPH-diesel, TPH-motor-oil, or TPH-fuel-oil as follows:

- **TPH-diesel:** TPH-diesel, diesel, gasoline-diesel, unknown diesel-range, total recoverable petroleum hydrocarbons (TRPH)
- **TPH-motor-oil:** TPH-motor-oil, motor oil, unknown motor-oil-range
- **TPH-fuel-oil:** fuel oil, fuel oil #1, fuel oil #2, Mare Island Fuel, oil and grease, TPH-other

The carbon range that comprises TPH-fuel-oil (C14 to C32) is encompassed in the analyses for TPH-diesel (C12 to C24) and TPH-motor-oil (C24 to C36); consequently, soil and groundwater samples collected during 2003 were analyzed for TPH-diesel and TPH-motor-oil in accordance with the final SAP for the FOPL (CH2M HILL 2003a). Soil samples were also analyzed for PAHs when petroleum hydrocarbons were detected at concentrations that exceeded Tier 1 ESLs. Additional soil and groundwater samples were collected at step-out locations when petroleum hydrocarbons and/or PAHs were detected in soil samples collected during the limited investigation at concentrations exceeding Tier 1 ESLs. Step-out

borings were generally advanced 10 to 15 feet downgradient of the limited investigation boring locations for purposes of site characterization.

TABLE 1.4-1
Tier 1 ESLs for TPH and BTEX Compounds in Soil and Groundwater
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

Future Land Use	TPH-gasoline		TPH-diesel		TPH-fuel-oil ^a		TPH-motor-oil		Benzene		Toluene		Ethylbenzene		Xylene	
Depth	<10 feet bgs	> 10 feet bgs	<10 feet bgs	> 10 feet bgs	<10 feet bgs	> 10 feet bgs	<10 feet bgs	> 10 feet bgs	<10 feet bgs	> 10 feet bgs	<10 feet bgs	> 10 feet bgs	<10 feet bgs	> 10 feet bgs	<10 feet bgs	> 10 feet bgs
Industrial (mg/kg)	400	400	500	500	500	500	1,000	1,000	0.38	0.5	9.3	9.3	13	13	1.5	1.5
Residential (mg/kg)	400	400	500	500	500	500	500	1,000	0.18	0.18	9.3	9.3	4.7	4.7	1.5	1.5
Groundwater (non-potable) (µg/L)	500	500	640	640	640	640	640	640	46	46	130	130	290	290	13	13

^aTier 1 ESLs for TPH-diesel are presented for TPH-fuel-oil.

Source: RWQCB 2003.

Notes:

mg/kg = milligrams per kilogram.
µg/L = micrograms per liter.

TABLE 1.4-2
Tier 1 ESLs for PAH Compounds in Soil and Groundwater
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

Future Land Use	Acenaphthene		Acenaphthylene		Anthracene		Benzo(a)anthracene		Benzo(b)fluoranthene		Benzo(k)fluoranthene		Benzo(g,h,i)perylene		Benzo(a)pyrene		Chrysene		Dibenzo(a,h)anthracene		Fluoranthene		Fluorene		Ideno(1,2,3-cd)pyrene		Napthalene		Phenanthrene		Pyrene	
Depth	<10 feet bgs	>10 feet bgs	<10 feet bgs	>10 feet bgs	<10 feet bgs	>10 feet bgs	<10 feet bgs	>10 feet bgs	<10 feet bgs	>10 feet bgs	<10 feet bgs	> 10 feet bgs	<10 feet bgs	>10 feet bgs	<10 feet bgs	> 10 feet bgs	<10 feet bgs	>10 feet bgs	<10 feet bgs	> 10 feet bgs	<10 feet bgs	>10 feet bgs	<10 feet bgs	>10 feet bgs	<10 feet bgs	> 10 feet bgs	<10 feet bgs	>10 feet bgs	<10 feet bgs	>10 feet bgs	<10 feet bgs	>10 feet bgs
Industrial (mg/kg)	19	19	13	13	2.8	2.8	1.3	12	1.3	15	1.3	15	2.7	27	0.13	1.5	13	23	0.38	4.3	40	60	8.9	8.9	1.3	7.7	4.8	4.8	11	11	85	85
Residential (mg/kg)	19	19	13	13	2.8	2.8	0.38	12	0.38	15	0.38	15	2.7	27	0.038	1.5	3.8	23	0.11	4.3	40	60	8.9	8.9	0.38	7.7	4.5	4.5	11	11	85	85
Groundwater (non-potable) (µg/L)	23	23	30	30	0.73	0.73	0.027	0.027	0.029	0.029	0.40	0.029	0.1	0.1	0.014	0.014	0.35	0.35	0.25	0.25	8	8	3.9	3.9	0.029	0.029	24	24	4.6	4.6	2	2

Source: RWQCB 2003.

TABLE 1.4-3
Tier 2 Screening Levels for COPCs in Soils at FOPL Segments in IA B and C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment/COPCs	Odors/Nuisance ^a (0-10 feet bgs) mg/kg	Urban Area Ecotoxicity Criteria ^b (0-10 feet bgs) mg/kg	Human Health		Groundwater Protection from Soil Leaching ^c mg/kg	Ceiling Values mg/kg	Tier 2 Screening Level ^d (mg/kg)	Maximum Concentration (mg/kg)	95% UCL (mg/kg)	EPC (mg/kg)	Basis	Exceeds Tier 2 Value?
			Direct Exposure mg/kg	Indoor Air Impacts mg/kg								
Industrial Sites:												
G1/X/B121												
TPH (gasoline) 0-10 feet bgs	NA	NA	9,667 ^e	NA	41,724	5,000 ^f	5,000	780	NA	780	Max. Conc.	No
TPH (middle distillates) 0-10 feet bgs	NA	NA	9,667 ^e	NA	41,724	10,000 ^f	9,667	8,600	NA	8,600	Max. Conc.	No
TPH (middle distillates) >10 feet bgs	NA	NA	110,000 ^g	NA	41,724	10,000 ^f	10,000	1,500	NA	1,500	Max. Conc.	No
TPH (residual fuels) 0-10 feet bgs	NA	NA	9,667 ^e	NA	41,724	10,000 ^f	9,667	3,400	NA	3,400	Max. Conc.	No
G1/X/B207S												
TPH (middle distillates) 0-10 feet bgs	NA	NA	29,000 ^e	NA	41,724	10,000 ^f	10,000	6,000	NA	6,000	Max. Conc.	No
G1/X/BE10												
TPH (middle distillates) >10 feet bgs	NA	NA	55,000 ^g	NA	41,724	10,000 ^f	10,000	3,800	NA	3,800	Max. Conc.	No
TPH (middle distillates) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	4,300	NA	4,300	Max. Conc.	No
TPH (residual fuels) >10 feet bgs	NA	NA	55,000 ^g	NA	41,724	10,000 ^f	10,000	3,500	NA	3,500	Max. Conc.	No
TPH (residual fuels) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	1,500	NA	1,500	Max. Conc.	No
G1/2/B207												
TPH (residual fuels) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	18,000	NA	18,000	Max. Conc.	Yes
TPH (middle distillates) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	6,400	NA	6,400	Max. Conc.	No
G1/X/B493												
TPH (middle distillates) >10 feet bgs	NA	NA	55,000 ^g	NA	41,724	10,000 ^f	10,000	7,400	NA	7,400	Max. Conc.	No
TPH (residual fuels) >10 feet bgs	NA	NA	55,000 ^g	NA	41,724	10,000 ^f	10,000	9,500	NA	9,500	Max. Conc.	No
G1/6/B971												
TPH (middle distillates) >10 feet bgs	NA	NA	36,667 ^g	NA	41,724	10,000 ^f	10,000	33,000	13,000	13,000	95% UCL- Bootstrap-t	Yes
TPH (residual fuels) 0-10 feet bgs	NA	NA	9,667 ^e	NA	41,724	10,000 ^f	9,667	4,500	NA	4,500	Max. Conc.	No
TPH (residual fuels) >10 feet bgs	NA	NA	36,667 ^g	NA	41,724	10,000 ^f	10,000	11,000	4,500	4,500	95% UCL- Bootstrap-t	No
TPH (middle distillates) 0-10 feet bgs	NA	NA	9,667 ^e	NA	41,724	10,000 ^f	9,667	6,100	2,900	2,900	95% UCL- Bootstrap-t	No
Anthracene >10 feet bgs	NA	NA	366,667 ^g	NOC	88	5,000 ⁱ	88	24	37	24	Max. Conc.	No
Fluorene 0-10 feet bgs	NA	NA	8,667 ^e	NOC	1,250	2,500 ⁱ	1,250	14	NA	14	Max. Conc.	No
G1/6/7E, G1/10/7E, and G1/10/BE10												
TPH (middle distillates) >10 feet bgs	NA	NA	55,000 ^g	NA	41,724	10,000 ^f	10,000	4,300	1,300	1,300	95%-Bootstrap-t	No
TPH (residual fuels) >10 feet bgs	NA	NA	55,000 ^g	NA	41,724	10,000 ^f	10,000	9,000	14,000	9,000	Max. Conc.	No
TPH (residual fuels) 0-10 feet bgs	NA	NA	5,800 ^e	NA	41,724	10,000 ^f	5,800	13,000	1,200	1,200	95%-Bootstrap-t	No
TPH (middle distillates) 0-10 feet bgs	NA	NA	5,800 ^e	NA	41,724	10,000 ^f	5,800	30,000	1,800	1,800	95%-Bootstrap-t	No
Anthracene 0-10 feet bgs	NA	NA	48,000 ^e	NOC	88	2,500 ⁱ	88	14	3	3.0	95%-Bootstrap-t	No
Benzo(a)anthracene 0-10 feet bgs	NA	NA	13 ^j	NA	170	2,500 ⁱ	13	3	6.9	3.0	Max. Conc.	No
Benzo(g,h,l)perylene 0-10 feet bgs	NA	NA	4,400 ^e	NA	35	2,500 ⁱ	35	10	5.8	5.8	95%-Bootstrap-t	No
Benzo(a)pyrene 0-10 feet bgs	NA	NA	1.3 ^j	NA	1,730	2,500 ⁱ	1.3	17	2.2	2.2	95%-Bootstrap-t	Yes
Benzo(b)fluoranthene 0-10 feet bgs	NA	NA	13 ^j	NA	640	2,500 ⁱ	13	19	5.3	5.3	95%-Bootstrap-t	No
Chrysene 0-10 feet bgs	NA	NA	130 ^j	NA	53	2,500 ⁱ	53	36	13	13	95%-Bootstrap-t	No

TABLE 1.4-3
Tier 2 Screening Levels for COPCs in Soils at FOPL Segments in IA B and C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment/COPCs	Odors/Nuisance ^a (0-10 feet bgs) mg/kg	Urban Area Ecotoxicity Criteria ^b (0-10 feet bgs) mg/kg	Human Health		Groundwater Protection from Soil Leaching ^c mg/kg	Ceiling Values mg/kg	Tier 2 Screening Level ^d (mg/kg)	Maximum Concentration (mg/kg)	95% UCL (mg/kg)	EPC (mg/kg)	Basis	Exceeds Tier 2 Value?
			Direct Exposure mg/kg	Indoor Air Impacts mg/kg								
Dibenzo(a,h)anthracene 0-10 feet bgs	NA	NA	3.8 ⁱ	NA	140	2,500 ⁱ	3.8	4	0.45	0.45	95%-Bootstrap-t	No
Fluoranthene 0-10 feet bgs	NA	NA	4,400 ^e	NA	820	2,500 ⁱ	820	170	78	78	95%-Bootstrap-t	No
Ideno(1,2,3-c,d)pyrene 0-10 feet bgs	NA	NA	13 ^j	NA	72	2,500 ⁱ	13	9	1.8	1.8	95%-Bootstrap-t	No
Phenanthrene 0-10 feet bgs	NA	NA	5,200 ^e	NA	950	2,500 ⁱ	950	180	290	180	Max. Conc.	No
Pyrene 0-10 feet bgs	NA	NA	5,800 ^e	NOC	770	2,500 ⁱ	770	170	210	170	Max. Conc.	No
G1/6/WTRF												
TPH (middle distillates) 0-10 feet bgs	NA	NA	29,000 ^e	NA	41,724	10,000 ^f	10,000	2,600	NA	2,600	Max. Conc.	No
TPH (middle distillates) >10 feet bgs	NA	NA	110,000 ^g	NA	41,724	10,000 ^f	10,000	2,300	NA	2,300	Max. Conc.	No
G1/8/8ST												
TPH (middle distillates) 0-10 feet bgs	NA	NA	29,000 ^e	NA	41,724	10,000 ^f	10,000	740	NA	740	Max. Conc.	No
H1/X/B207S												
TPH (middle distillates) >10 feet bgs	NA	NA	110,000 ^g	NA	41,724	10,000 ^f	10,000	560	NA	560	Max. Conc.	No
TPH (residual fuels) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	3,300	NA	3,300	Max. Conc.	No
TPH (middle distillates) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	11,000	5,700	5,700	95%-Bootstrap-t	No
H1/2/B207B												
TPH (middle distillates) >10 feet bgs	NA	NA	110,000 ^g	NA	41,724	10,000 ^f	10,000	730	300	300	95%-Bootstrap-t	No
H1/2/B207A												
TPH (middle distillates) >10 feet bgs	NA	NA	110,000 ^g	NA	41,724	10,000 ^f	10,000	660	NA	660	Max. Conc.	No
TPH (residual fuels) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	3,000	1,900	1,900	95%-Bootstrap-t	No
TPH (middle distillates) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	3,100	1,700	1,700	95%-Bootstrap-t	No
H1/2.5/CALIF												
TPH (middle distillates) 0-10 feet bgs	NA	NA	29,000 ^e	NA	41,724	10,000 ^f	10,000	3,800	NA	3,800	Max. Conc.	No
G1/4/3ST												
TPH (middle distillates) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	11,000	1,800	1,800	95%-Bootstrap-t	No
TPH (residual fuels) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	8,200	1,800	1,800	95%-Bootstrap-t	No
G1/4/BE3BE8												
TPH (middle distillates) 0-10 feet bgs	NA	NA	5,800 ^e	NA	41,724	10,000 ^f	10,000	2,200	NA	2,200	Max. Conc.	No
Acenaphthene 0-10 feet bgs	NA	NA	5,800 ^e	NOC	163	2,500 ⁱ	163	100	NA	100	Max. Conc.	No
Anthracene 0-10 feet bgs	NA	NA	48,000 ^e	NOC	88	2,500 ⁱ	88	82	NA	82	Max. Conc.	No
Benzo(a)anthracene 0-10 feet bgs	NA	NA	13 ^j	NA	166	2,500 ⁱ	13	24	NA	24	Max. Conc.	Yes
Chrysene 0-10 feet bgs	NA	NA	13 ^j	NA	53	2,500 ⁱ	13	24	NA	24	Max. Conc.	Yes
Fluoranthene 0-10 feet bgs	NA	NA	4,400 ^e	NA	820	2,500 ⁱ	820	160	NA	160	Max. Conc.	No
Fluorene 0-10 feet bgs	NA	NA	5,200 ^e	NOC	1246	2,500 ⁱ	1,246	96	NA	96	Max. Conc.	No
Naphthalene 0-10 feet bgs	NA	NA	37 ^e	141	43	2,500 ⁱ	37	33	NA	33	Max. Conc.	No
Pyrene 0-10 feet bgs	NA	NA	5,800 ^e	NOC	768	2,500 ⁱ	768	120	NA	120	Max. Conc.	No
Benzo(a)pyrene 0-10 feet bgs	NA	NA	1.3 ^j	NA	1,730	2,500 ⁱ	1.3	0.18	NA	0.18	Max. Conc.	No
H1/2/B111												
TPH (middle distillates) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	18,000	4,000	4,000	95%-Bootstrap-t	No
TPH (middle distillates) >10 feet bgs	NA	NA	110,000 ^g	NA	41,724	10,000 ^f	10,000	700	NA	700	Max. Conc.	No

TABLE 1.4-3
Tier 2 Screening Levels for COPCs in Soils at FOPL Segments in IA B and C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment/COPCs	Odors/Nuisance ^a (0-10 feet bgs) mg/kg	Urban Area Ecotoxicity Criteria ^b (0-10 feet bgs) mg/kg	Human Health		Groundwater Protection from Soil Leaching ^c mg/kg	Ceiling Values mg/kg	Tier 2 Screening Level ^d (mg/kg)	Maximum Concentration (mg/kg)	95% UCL (mg/kg)	EPC (mg/kg)	Basis	Exceeds Tier 2 Value?
			Direct Exposure mg/kg	Indoor Air Impacts mg/kg								
TPH (residual fuels) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	15,000	4,500	4,500	95%-Bootstrap-t	No
Benzo(a)pyrene 0-10 feet bgs	NA	NA	1.3 ^j	NA	1,730	2,500 ⁱ	1.3	0.55	0.66	0.55	Max. Conc.	No
H1/2/B271												
TPH (middle distillates) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	7,300	NA	7,300	Max. Conc.	No
TPH (residual fuels) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	1,500	NA	1,500	Max. Conc.	No
H1/2/B85S												
TPH (middle distillates) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	14,000	8,900	8,900	95%-Bootstrap-t	No
TPH (residual fuels) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	11,000	5,800	5,800	95%-Bootstrap-t	No
Benzo(a)pyrene 0-10 feet bgs	NA	NA	1.3 ^j	NA	1,730	2,500 ⁱ	1.3	0.74	NA	0.74	Max. Conc.	No
H1/2/B89												
TPH (middle distillates) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	9,400	2,000,000	9,400	Max. Conc.	No
TPH (residual fuels) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	2,200	NA	2,200	Max. Conc.	No
TPH (middle distillates) >10 feet bgs	NA	NA	110,000 ^g	NA	41,724	10,000 ^f	10,000	880	720	720	95%-Bootstrap-t	No
Benzo(a)pyrene 0-10 feet bgs	NA	NA	1.3 ^j	NA	1,730	2,500 ⁱ	1.3	0.34	NA	0.34	Max. Conc.	No
H1/6/B85												
TPH (middle distillates) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	16,000	4,700	4,700	95%-Bootstrap-t	No
TPH (residual fuels) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	10,000	5,000	5,000	95%-Bootstrap-t	No
TPH (middle distillates) >10 feet bgs	NA	NA	55,000 ^g	NA	41,724	10,000 ^f	10,000	4,500	NA	4,500	Max. Conc.	No
TPH (residual fuels) >10 feet bgs	NA	NA	55,000 ^g	NA	41,724	10,000 ^f	10,000	4,600	NA	4,600	Max. Conc.	No
I1/6/B693A&B, I1/6/B473A&B, and I1/4/B471												
TPH (middle distillates) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	10,000 ^f	10,000	16,000	1,800	1,800	95%-Bootstrap-t	No
TPH (middle distillates) >10 feet bgs	NA	NA	55,000 ^g	NA	41,724	10,000 ^f	10,000	1,800	840	840	95%-Bootstrap-t	No
TPH (gasoline) 0-10 feet bgs	NA	NA	14,500 ^e	NA	41,724	5,000 ^f	5,000	1,000	430	430	95%-Bootstrap-t	No
Benzo(a)pyrene 0-10 feet bgs	NA	NA	1.3 ^j	NA	1,730	2,500 ⁱ	1.3	0.75	0.66	0.75	Max. Conc.	No
Napthalene >10 feet bgs	NA	NA	1,150 ^g	NA	42.5	5,000 ⁱ	42.5	11	13	11	Max. Conc.	No

^aSource: RWQCB 2003, Table B-2 for industrial sites

^bSource: RWQCB 2003, Table B-2 and D-2 for industrial sites

^cCalculated from RWQCB Leaching Formula (RWQCB 2003) for protection of Tier 2 screening levels for groundwater.

^dThe Tier 2 screening level is the lowest of all applicable concerns.

^eSource: RWQCB 2003, Table K-2 for COPCs 0-10 feet bgs based on a hazard index of 1, divided by the number of COPCs for 0-10 feet bgs. Maximum number of COPCs used in deriving screening level is 5. Screening level for Pyrene (29,000 mg/kg) used for TPH.

^fSource: MADEP 2001

^gSource: RWQCB 2003, Table K-3 for COPCs >10 feet bgs based on a hazard index of 1, divided by the number of COPCs for >10 feet bgs. Maximum number of COPCs used in deriving screening level is 5. Screening level for Pyrene (110,000 mg/kg) used for TPH.

^hSource: RWQCB 2003, Tables E-1b.

ⁱSource: RWQCB 2003, Tables H-1, Ceiling level for non-odorous chemicals

^jSource: RWQCB 2003, Table K-2 (0-10 feet bgs) or Table K-3 (>10 feet bgs) multiplied by 10 (using risk of 10⁻⁵ instead of 10⁻⁶ for carcinogenic COPCs).

Notes:

NA = not applicable.

NOC = Not of Concern. The calculated risk-based soil concentration is at or above the solubility limit and is not of concern for the indoor air exposure pathway.

TABLE 1.4-4
Tier 2 Screening Levels for COPCs in Groundwater at FOPL Segments in IA B and C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment/COPCs	Odor/Nuisance ^a (mg/L)	Indoor Air Impacts ^b (mg/L)	Aquatic Life Protection (µg/L)		General Groundwater Degradation ^a (Upper Concentration Limit) (mg/L)	Tier 2 Screening Level ^d (mg/L)	Maximum Concentration (mg/L)	95% UCL (mg/L)	EPC (mg/L)	Basis	Exceeds Tier 2 Value?
			Wetlands	Strait ^c							
G1/X/B121											
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	1,700	NA	1,700	Max. Conc.	No
TPH (residual fuels)	NA	NA	NA	NA	50,000	50,000	820	NA	820	Max. Conc.	No
G1/X/BE10 ^e											
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	850	NA	850	Max. Conc.	No
G1/2/B207											
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	600	NA	600	Max. Conc.	No
TPH (residual fuels)	NA	NA	NA	NA	50,000	50,000	780	NA	780	Max. Conc.	No
G1/X/B493											
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	710	NA	710	Max. Conc.	No
TPH (residual fuels)	NA	NA	NA	NA	50,000	50,000	730	NA	730	Max. Conc.	No
G1/6/B971 ^e											
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	1,000	NA	1,000	Max. Conc.	No
TPH (residual fuels)	NA	NA	NA	NA	50,000	50,000	900	NA	900	Max. Conc.	No
G1/6/7E, G1/10/7E, and G1/10/BE10 ^e											
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	92,000	41,000	41,000	95% UCL- Bootstrap-t	No
TPH (residual fuels)	NA	NA	NA	NA	50,000	50,000	1,500	1,200	1,200	95% UCL- Bootstrap-t	No
Benzo(a)pyrene	NA	NA	NA	NA	50,000	50,000	0.47	2.2	0.47	Max. Conc.	No
Benzo(a)anthracene	NA	NA	NA	NA	50,000	50,000	6	3.6	3.6	95% UCL- Bootstrap-t	No
Chrysene	NA	NA	NA	NA	50,000	50,000	0.6	19	0.6	Max. Conc.	No
Flouranthene	NA	NA	NA	NA	50,000	50,000	14	2.7	2.7	95% UCL- Bootstrap-t	No
Fluorene	NA	NOC	NA	NA	50,000	50,000	6.3	6.5	6.3	Max. Conc.	No
G1/6/WTRP ^e											
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	2,500	550	550	95% UCL- Bootstrap-t	No
TPH (residual fuels)	NA	NA	NA	NA	50,000	50,000	3,400	850	850	95% UCL- Bootstrap-t	No
H1/X/B207S											
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	4,000	NA	4,000	Max. Conc.	No
TPH (residual fuels)	NA	NA	NA	NA	50,000	50,000	2,200	NA	2,200	Max. Conc.	No
H1/2/B207A											
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	7,800	NA	7,800	Max. Conc.	No
TPH (residual fuels)	NA	NA	NA	NA	50,000	50,000	5,700	NA	5,700	Max. Conc.	No
Chrysene	NA	NA	NA	NA	50,000	50,000	1.0	NA	1.0	Max. Conc.	No
Fluorene	NA	NOC	NA	NA	50,000	50,000	5.3	NA	5.3	Max. Conc.	No
H1/2/B207B											
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	2,200	NA	2,200	Max. Conc.	No

TABLE 1.4-4
Tier 2 Screening Levels for COPCs in Groundwater at FOPL Segments in IA B and C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment/COPCs	Odor/Nuisance ^a (mg/L)	Indoor Air Impacts ^b (mg/L)	Aquatic Life Protection (µg/L)		General Groundwater Degradation ^a (Upper Concentration Limit) (mg/L)	Tier 2 Screening Level ^d (mg/L)	Maximum Concentration (mg/L)	95% UCL (mg/L)	EPC (mg/L)	Basis	Exceeds Tier 2 Value?
			Wetlands	Strait ^c							
TPH (residual fuels) H1/X/B87	NA	NA	NA	NA	50,000	50,000	1,300	NA	1,300	Max. Conc.	No
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	1,200	NA	1,200	Max. Conc.	No
TPH (residual fuels) H1/2.5/CALIF	NA	NA	NA	NA	50,000	50,000	1,000	NA	1,000	Max. Conc.	No
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	1,100	NA	1,100	Max. Conc.	No
TPH (residual fuels) G1/4/3ST	NA	NA	NA	NA	50,000	50,000	1,500	NA	1,500	Max. Conc.	No
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	2,600	NA	2,600	Max. Conc.	No
TPH (residual fuels) H1/2/B111	NA	NA	NA	NA	50,000	50,000	1,200	NA	1,200	Max. Conc.	No
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	3,400	NA	3,400	Max. Conc.	No
TPH (residual fuels) H1/2/B271	NA	NA	NA	NA	50,000	50,000	4,600	NA	4,600	Max. Conc.	No
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	5,800	NA	5,800	Max. Conc.	No
TPH (residual fuels) H1/2/B85S^e	NA	NA	NA	NA	50,000	50,000	2,000	NA	2,000	Max. Conc.	No
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	1,600	NA	1,600	Max. Conc.	No
TPH (residual fuels) H1/2/B89^e	NA	NA	NA	NA	50,000	50,000	1,100	NA	1,100	Max. Conc.	No
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	51,000	NA	51,000	Max. Conc.	Yes
TPH (residual fuels)	NA	NA	NA	NA	50,000	50,000	31,000	NA	31,000	Max. Conc.	No
Chrysene	NA	NA	NA	NA	50,000	50,000	0.62	0.23	0.23	95% UCL- Bootstrap-t	No
H1/6/B85											
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	5,800	NA	5,800	Max. Conc.	No
TPH (residual fuels)	NA	NA	NA	NA	50,000	50,000	3,100	NA	3,100	Max. Conc.	No
I1/6/B693A&B, I1/6/B473A&B, and I1/4/B471^e											
TPH (middle distillates)	NA	NA	NA	NA	50,000	50,000	570,000	58,000	58,000	95% UCL- Bootstrap-t	Yes
TPH (residual fuels)	NA	NA	NA	NA	50,000	50,000	8,000	6,500	6,500	95% UCL- Bootstrap-t	No
TPH (gasoline)	NA	NA	NA	NA	50,000	50,000	4,900	830	830	95% UCL- Bootstrap-t	No
anthracene	NA	NOC	NA	NA	50,000	50,000	2.4	5.3	2.4	Max. Conc.	No
benzo(a)anthracene	NA	NA	NA	NA	50,000	50,000	19	5.4	5.4	95% UCL- Bootstrap-t	No
Benzo(a)pyrene	NA	NA	NA	NA	50,000	50,000	21	5.6	5.6	95% UCL- Bootstrap-t	No
Benzo(b)fluoranthene	NA	NA	NA	NA	50,000	50,000	23	5.7	5.7	95% UCL- Bootstrap-t	No
Benzo(g,h,i)perylene	NA	NA	NA	NA	50,000	50,000	6	NA	6	Max. Conc.	No

TABLE 1.4-4
Tier 2 Screening Levels for COPCs in Groundwater at FOPL Segments in IA B and C1
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

FOPL Segment/COPCs	Odor/Nuisance ^a (mg/L)	Indoor Air Impacts ^b (mg/L)	Aquatic Life Protection (µg/L)		General Groundwater Degradation ^a (Upper Concentration Limit) (mg/L)	Tier 2 Screening Level ^d (mg/L)	Maximum Concentration (mg/L)	95% UCL (mg/L)	EPC (mg/L)	Basis	Exceeds Tier 2 Value?
			Wetlands	Strait ^c							
Benzo(k)fluoranthene	NA	NA	NA	NA	50,000	50,000	22	5.7	5.7	95% UCL- Bootstrap-t	No
Chrysene	NA	NA	NA	NA	50,000	50,000	14	5.2	5.2	95% UCL- Bootstrap-t	No
Dibenz(a,h)anthracene	NA	NA	NA	NA	50,000	50,000	3	5.4	3	Max. Conc.	No
Fluoroanthene	NA	NA	NA	NA	50,000	50,000	110	16	16	95% UCL- Bootstrap-t	No
Fluroene	NA	NOC	NA	NA	50,000	50,000	13	3.4	3.4	95% UCL- Bootstrap-t	No
Ideno(1,2,3-c,d)pyrene	NA	NA	NA	NA	50,000	50,000	7	5.3	5.3	95% UCL- Bootstrap-t	No
Napthalene	NA	NOC	NA	NA	50,000	50,000	40	8.5	8.5	95% UCL- Bootstrap-t	No
Phenanthrene	NA	NA	NA	NA	50,000	50,000	35	24	24	95% UCL- Bootstrap-t	No
Pyrene	NA	NOC	NA	NA	50,000	50,000	26	6.1	6.1	95% UCL- Bootstrap-t	No
Xylene	NA	NOC	NA	NA	50,000	50,000	53	24.5	24.5	95% UCL- Bootstrap-t	No

^aSource: RWQCB 2003, Table I-2.
^bValue for Indoor Air Quality (RWQCB 2003, Table E-1a).
^cValue for Aquatic Life Protection (RWQCB 2003, Table F-4a).
^dThe Tier 2 screening level is the lowest of all applicable concerns.
^eLocated within 250 feet of the Mare Island Strait.

Notes:
Units are µg/L.
NA = not applicable.
NOC = Not of Concern. The calculated risk-based groundwater concentration is at or above the solubility limit and is not of concern for the indoor air exposure pathway.

2.0 Site Background

This section provides a brief description and history of Mare Island, the FOPL, IA B, and IA C1.

2.1 Description and History of Mare Island

MINS is located on a peninsula approximately 30 miles northeast of San Francisco. The peninsula is bounded to the east, south, and west by the Napa River (Mare Island Strait), Carquinez Strait, and San Pablo Bay, respectively. Mare Island was originally an island covering approximately 1,000 acres, with surrounding wetlands of approximately 300 acres. Over time, the placement of fill materials and dredge tailings has transformed the island to the current peninsula, which covers more than 5,600 acres.

The United States Department of the Navy (Navy) purchased Mare Island in 1853 and commenced shipbuilding operations the following year. The primary ship construction and maintenance area of MINS was established along the northeastern shore of the original island, in IA C1, adjacent to Mare Island Strait. The entire facility underwent vast transformations during its years of operation, as shipbuilding technologies advanced from wooden to steel construction and wind power to nuclear propulsion. In the early 1920s, the Navy initiated construction and maintenance of submarines at MINS. During World War II, MINS reached peak capacity for shipbuilding, repair, overhaul, and maintenance. Following the war, MINS was considered a primary station for construction and maintenance of the Navy's Pacific fleet of submarines. However, because of changing needs in a postwar environment, shipyard activity decreased. The former MINS was closed on April 1, 1996, after 143 years of operation.

2.2 Description and History of Investigation Area B

IA B is located in the north-central portion of Mare Island (Figure 2.2-1)(all figures are located at the end of each section). The approximately 90-acre area is bounded to the north by G Street, to the east by Railroad Avenue, and to the south by Connolly Street (formerly known as 3rd Street). The western boundary of IA B is defined by Azuar Drive (formerly Cedar Avenue) and includes a small parcel immediately north of Dump Road and west of Azuar Drive. Light industrial areas exist to the north, east, and south of IA B. Land west of IA B includes non-tidal wetlands and the former Defense Reutilization and Marketing Office scrapyard. While the site historically has been used largely for industrial purposes, some portions of IA B are planned for future residential land use. The remaining areas of IA B are planned for mixed use (i.e., office/research and development) and light industrial purposes. The proposed future land use for IA B is presented in Figure 2.2-2.

Approximately 45 existing buildings and structures are located within IA B. The land surrounding the buildings is mostly paved. Historically, the majority of the land comprising IA B was not a part of the original island and was reclaimed by the fill soil and dredged

sediments. The portion of IA B east of Azuar Drive is within the MINS Historic District, with the earliest buildings dating from 1918. The majority of the buildings and structures in IA B were constructed in the 1930s, 1940s, and 1950s. The buildings were used for transportation, equipment repair, crane maintenance and testing, public works maintenance, warehouse facilities, military barracks and training facilities, and a variety of community service and recreational facilities (SSPORTS 1996a-b). Approximately 35 individual buildings/structures have been deconstructed or relocated, primarily during the late 1940s.

2.3 Description and History of Investigation Area C1

IA C1 is located along the northeastern side of the island and consists of about 84 acres. This investigation area is bounded by G Street to the north, by Mare Island Strait to the east, by Ways 1 and 8th Street to the south, and by Railroad Avenue to the west. Figure 2.2-1 shows the location of IA C1. One hundred thirty buildings are currently located in IA C1. With the exception of Wichels Park in the south of IA C1, land surrounding the buildings is paved with either concrete, gravel, or asphalt. The area within IA C1 north of A Street and along Mare Island Strait was reclaimed by the placement of fill soil and dredged sediments. The southern portion of IA C1 is located within the original island perimeter.

Development of IA C1 began in the late 1850s. The three original buildings (Buildings 71, 85, and 87) were constructed in 1858. Building 71 was built as a storehouse, Building 85 was built as an iron and brass foundry, and Building 87 was built as a machine shop for ship boilers and machinery repair. Subsequently, the parcels within IA C1 were used for shipyard industrial and military activities. These activities included ship berthing and outfitting, electroplating of ship components, diesel fuel and oil storage and purification, steam cleaning, ship battery overhaul and refurbishment, hydraulic oil reclamation, lead casting, pipe fabrication, ship design, coffee roasting, printing, machine shop operations, and shipyard cafeteria food services (MINS 1996). IA C1 also includes a former police station with a basement shooting range, Wichels Park, the Shipyard Central Fire Station, computer and telephone central operations, coal storage sheds, the Shipyard Post Office, the Shipyard Power Plant, and several large administrative office buildings (MINS 1996). Demolished buildings include an observatory, a blacksmithing shop, portable airplane hangars, military World War II Quonset huts, a radio office, a submarine crew bunkhouse, a coke bin and coal silos, and a coffee roasting plant. According to the *Preliminary Land Use Plan* (LMI 2000), IA C1 is currently zoned for mixed-use of light industry and a research park. The proposed future land use of IA C1 is presented in Figure 2.2-2.

2.4 Description and History of the Fuel-oil Pipeline

The FOPL distribution system was used to transport fuel oil across the former MINS between underground storage tanks (USTs) and aboveground storage tanks (ASTs), buildings, and work areas. The USTs and ASTs were used primarily for oil-fired, steam-driven machinery and to store heating oil for steam-heat boilers. Additionally, FOPL segments extended to the Mare Island Strait for conveyance of fuel oil to ships.

FOPL segments were identified through a review of available historical plans, drawings, written documentation of previous investigations, and visual surveys. An estimated 51,000 linear feet of FOPL have been installed at MINS over a period of approximately 90 years. Approximately 49,000 feet of FOPL are located within the EETP. The remaining 2,000 feet of FOPL are located outside of the EETP in the vicinity of Mare Island Elementary School and Building 1294. Approximately 1,600 feet of FOPL are located within IA B, and approximately 14,400 feet of FOPL are located in IA C1. The location of the FOPL segments in IAs B and C1 are presented in Figure 2.4-1. Table 2.4-1 presents the total length of FOPL segments in IA B. Table 2.4-2 presents the total length of FOPL segments in IA C1. The investigative or remedial actions proposed for FOPL segments in IA B and IA C1 are also presented in Tables 2.4-1 and 2.4-2.

TABLE 2.4-1

Summary of EETP FOPL Segment Lengths in IA B

Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

Pipeline Segment	Pipeline Status					Proposed Investigative or Interim Remedial Action
	Removed (ft)	Flushed (ft)	Abandoned (ft)	Not Located (ft)	Total (ft)	
G1/4/3ST	176	130	0	0	306	No further action required.
G2/4/3ST	871	0	0	0	871	This FOPL segment and oil contamination in the vicinity of the FOPL will be addressed with future investigations of the Building 811 Area (CH2M HILL pending).
G2/2.5/3ST	0	0	0	284	284	This FOPL segment and oil contamination in the vicinity of the FOPL will be addressed with future investigations of the Building 811 Area (CH2M HILL pending).
G2/X/B637	145	0	0	0	145	No further action required. RWQCB has provided concurrence with this conclusion (RWQCB 2004a).
Total Segment Lengths in IA B	1,192	130	0	284	1,606	

TABLE 2.4-2

Summary of EETP FOPL Segment Lengths in IA C1

Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

Pipeline Segment	Pipeline Status					Proposed Investigative or Interim Remedial Action
	Removed (ft)	Flushed (ft)	Abandoned (ft)	Not Located (ft)	Total (ft)	
G1/10/8ST	0	0	0	65	65	No further action required. RWQCB has provided concurrence with this conclusion (RWQCB 2004b).
G1/8/8ST	74	0	0	0	74	No further action required.
G1/10/7E	772	110	0	0	882	Excavate contaminated soil.
G1/10/BE10	211	0	0	0	211	Excavate contaminated soil.
G1/6/7E	1,000	0	0	0	1,000	Excavate contaminated soil.
G1/X/BE10	0	0	0	169	169	Perform vacuum testing.
G1/2/B207	88	0	0	0	88	Excavate contaminated soil.
G1/X/B207B	0	0	0	25	25	No further action required.
H1/2/B207B	201	0	0	0	201	No further action required.
G1/4/3ST	275	32	0	0	307	No further action required.
G1/4/BE3BE8	754	0	0	0	754	Excavate contaminated soil.
H1/4/BE3BE8	1,196	152	0	0	1,348	No further action required.
I1/4/BE3BE8	0	2,882	0	0	2,882	No Further Action Required. RWQCB has provided concurrence with this conclusion (RWQCB 2004a).
G1/6/B829A&B	94	0	0	0	94	No further action required. RWQCB has provided concurrence with this conclusion (RWQCB 2004a).
G1/6/B971	0	0	0	175	175	Excavate contaminated soil.
G1/X/B493	0	0	0	860	860	No further action required.
G1/6/WTRF	1,096	125	0	0	1,221	Perform quarterly groundwater monitoring.
G1/8/7E	96	55	0	0	151	No further action required. RWQCB has provided concurrence with this conclusion (RWQCB 2004a).
G1/X/B121	120	0	0	0	120	No further action required.
G1/X/B207S	215	0	0	25	240	No further action required.
H1/X/B207S	201	0	0	0	201	No further action required.
G1/X/BE9	0	0	0	64	64	No further action required.
H1/2.5/CALIF	383	0	0	0	383	No further action required.
H1/2/B111	318	179	0	0	497	No further action required.
H1/2/B207A	100	0	0	0	100	No further action required.
H1/2/B271	0	0	0	117	117	No further action required.
H1/6/B85	0	0	0	300	300	Perform vacuum testing.
H1/X/B87	0	0	0	52	52	No further action required.

TABLE 2.4-2

Summary of EETP FOPL Segment Lengths in IA C1

Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

Pipeline Segment	Pipeline Status					Proposed Investigative or Interim Remedial Action
	Removed (ft)	Flushed (ft)	Abandoned (ft)	Not Located (ft)	Total (ft)	
H1/2/B89	0	0	0	266	266	Install two monitoring wells. Perform quarterly monitoring.
H1/2/B85S	0	0	0	254	254	No further action required.
I1/4/B471	0	128	0	0	128	Remedial alternatives will be evaluated in a separate document consistent with Task C.10 of RWQCB Order R2-2002-0105 (RWQCB 2002).
I1/4/B477	155	15	10	0	180	No further action required. RWQCB has provided concurrence with this conclusion (RWQCB 2004a).
I1/6/B473A&B	0	82	0	102	184	Cut potential FOPL and perform vacuum testing after confirming utility type as FOPL.
I1/6/B693A&B	720	32	0	0	752	Remedial alternatives will be evaluated in a separate document consistent with Task C.10 of RWQCB Order R2-2002-0105 (RWQCB 2002).
I1/1.5/B289	0	0	0	74	74	Cut potential FOPL and perform vacuum testing after confirming utility type as FOPL.
Total Segment Lengths in IA C1	8,069	3,792	10	2,548	14,419	

Removal summary reports and limited internal Navy maps and documents have indicated that the pipeline varies from 2 to 10 inches in diameter. The FOPL is believed to be buried at depths up to 10 feet bgs. The pipelines are buried in a wide variety of soil types, including the artificially filled areas consisting of varying proportions of clay, silt, sand, gravel, and debris. Abrasive blast material (ABM) was occasionally used as fill material along pipeline trenches. Some of the pipelines are located above ground level, overhead in buildings, and under piers.

Field investigations have been performed along the FOPL between 1991 and 2003. The Navy FOPL work was summarized in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001) in February 2001. The Navy categorized 92 FOPL segments as either removed, flushed, abandoned in place, or not located (Weston 2001). Approximately 19,000 feet of FOPL were removed; 8,000 feet were flushed; 6,000 feet were abandoned in place; and 10,000 feet were not located during the initial FOPL investigation performed between 1996 and 1999 (Weston 2001). Figure 2.4-1 presents the removed, flushed, abandoned, and non-located segments in red, blue, green, and yellow, respectively.

The Navy performed further investigation along select FOPL segments between 1998 and 2000 (TtEMI and Knudsen 1999; TtEMI and Washington 2001). Soil and groundwater samples were collected along 27 FOPL segments during these investigations. Additional analytical data were collected along the FOPL during investigations associated with Installation Restoration Program (IRP) and UST sites between 1991 and 2003. In IA B, these investigations were performed at UST 637-1, UST 637-2, and the Building 811 Area. In IA C1, these investigations were performed at IR03, IR15, IR14, the Berth 10 Area, the Building 121 Area, domestic pump station (DOM) No. 6, Building 693, UST829, UST 121, and Cistern 87.

As a result of a historical Navy records review performed by CH2M HILL in 2002, 20 additional FOPL segments—one of which is located in IA B and four of which are located in IA C1—were identified that were not included in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). These additional segments were identified during an extensive review of published reports and unpublished Navy documents, figures, drawings, and maps. The total length of the 20 segments identified during this review is approximately 6,000 feet. The locations of these IA B and IA C1 FOPL segments are presented in orange in Figure 2.4-1.

2.5 Physical Characteristics of Investigation Areas B and C1

The physical characteristics for IA B and IA C1 are summarized below.

2.5.1 Surface Features

The topography of IA B is generally flat, with elevations of about 7 to 25 feet above mean sea level (msl). Approximately 45 existing buildings and structures are located within IA B, and the land surrounding the buildings is mostly paved. The topography of IA C1 is also generally flat, with elevations of about 6 to 20 feet above msl. Because IA C1 is within the former industrial area of Mare Island, the area is covered primarily with buildings and pavement. With the exception of Wichels Park, asphalt, concrete, gravel, or buildings cover IA C1.

2.5.1.1 Ecological Features

Major habitat types found at or around Mare Island include intertidal mudflats and open water, tidal wetlands, non-tidal wetlands, active dredge ponds, and uplands. These habitat types are described in detail in the ERAs for offshore and onshore areas of Mare Island (TtEMI 2000a, 2001a).

IA B and IA C1 consist predominantly of paved, covered areas. East of Azuar Drive in IA B and in IA C1, no viable onshore habitat exists because the sites are covered by buildings, asphalt, and concrete, with limited landscaping. The offshore areas at Mare Island consist of habitat below the mean high-tide line and generally include intertidal mudflats (located west of Mare Island), as well as open water. The northern portion of IA B is immediately adjacent Wetlands A, to the west. The remainder of IA B is bordered by IA C1, IA H2, IA H3, and IA D1. IA C1 is immediately adjacent to the open-water habitat of Mare Island Strait, which is predominantly deep-water habitat (primarily pelagic and benthic environments) without adjacent near-shore wetland habitat. The offshore habitat at Mare Island as a

whole consists primarily of pelagic and benthic environments that support diverse communities of algal, invertebrate, fish, bird, and mammal species.

2.5.1.2 Archaeological Features

Several archaeological and ethnographic areas were identified on Mare Island (City of Vallejo 1994). The prehistoric sites on Mare Island are among the last of their type known to lie relatively undamaged on the shoreline of San Pablo Bay. Significant archaeological resources need to be protected or recovered in advance of any undertakings (such as eliminating hazardous substances, contaminants, and pollutants) that might adversely affect these resources.

2.5.1.3 Surface Water

Surface water drainage within IA B and IA C1 is controlled primarily by the stormwater system. Because most of IA B and IA C1 are covered by either buildings or pavement, most rainwater does not infiltrate the ground but flows over the pavement surface to stormwater drains and is discharged into Mare Island Strait.

The Mare Island Strait is the end of the Napa River. The Napa River drains a 230-square-mile area to the north of the Mare Island peninsula. The river typically becomes brackish where it enters Mare Island Strait, northeast of Mare Island. With seasonal variability in salinity, flow, and sediment deposition, the aquatic environment surrounding Mare Island is highly dynamic.

2.5.2 Geology

The geology of Mare Island can be characterized as an eroded bedrock surface that is exposed in the southern part of the peninsula, overlain by a blanket of unconsolidated Quaternary sediments and artificial fill material at most other locations. The bedrock surface is irregular and deeply incised in some areas, and up to 160 feet of unconsolidated materials overlie the bedrock at some locations on the peninsula. The eroded bedrock forms a subsurface ridge, estimated to be the original extent of Mare Island in 1869, that extends northwest along the axis of the Mare Island peninsula, roughly coinciding with Azuar Drive. The northern extent of the subsurface bedrock ridge is not known, but the ridge is present at least as far north as A Street.

Three principal geologic units were identified at Mare Island. From top to bottom, stratigraphically, these units include: artificial fill material, unconsolidated natural deposits, and bedrock. The artificial fill material is a heterogeneous unit consisting of clay, silt, sand, gravel, and debris in varying proportions. The unconsolidated natural deposits consist primarily of a thick sequence of silty clays (commonly referred to as “Younger Bay Mud”) and intermediate and lower sand units. The bedrock consists of sandstone, siltstone, and shale.

2.5.2.1 Artificial Fill

Because of extensive land reclamation activities at Mare Island, a highly heterogeneous surficial layer of fill material is prevalent at locations outside of the original outline of the island. The fill material consists of silty clays, sands, gravels, organic debris, debris including concrete, asphalt, brick, metal, timber, paint chips, fiberglass, and other solid refuse and is characterized by abrupt and unpredictable changes in material in short lateral and vertical

distances. Thickness of the artificial fill varies from a minimum of about 1 to 2 feet on the southeastern side of IA B to a maximum of about 12 feet in the northern portion of IA B. The thickness of the artificial fill material in IA C1 varies from a few feet to about 15 feet. The northern half of IA C1 was created by the placement of artificial fill material from dredge spoils between 1852 and 1931.

2.5.2.2 Unconsolidated Natural Deposits

Unconsolidated natural deposits overlie the eroded bedrock surface on much of Mare Island. In IA B, the thickness of the Younger Bay Mud increases to the east (toward Mare Island Strait) and to the northwest, reflecting a steep dip in the underlying bedrock surface. Thickness varies from as little as 6 inches in the southern portion of IA B to more than 40 feet in the northern portion of IA B. The thickness of the unconsolidated original soil in IA C1 varies from not present to 30 feet thick.

2.5.2.3 Bedrock

Bedrock consists of brown, olive, and tan arkosic sandstone and siltstone. Bedrock occurs near ground surface in the southwestern portion of IA B and is approximately 40 feet bgs in the northern portion of IA B. The exposed bedrock is classified as undifferentiated Great Valley Sequence (Wagner and Burtungo 1982). A more detailed map by Dibblee (1981) identifies the bedrock as arkosic sandstone and micaceous shale of the Cretaceous Panoche Formation. Oakeshott (1978) describes the Great Valley Sequence as a thick wedge of siliciclastic sediments as much as 30,000 feet thick and consists of several formations, including the Panoche Formation.

2.5.3 Hydrogeology

One water-bearing zone was identified at Mare Island. Based on groundwater elevations measured during quarterly groundwater sampling events, groundwater flow in this aquifer is regionally influenced by the area of the original Mare Island, the area of the landfill, the wetlands to the west, and the adjacent dredge pond south of the landfill. Localized groundwater flow is strongly influenced by variations in lithology across the island. The water-bearing zone comprises both coarse-grained materials that act as preferential flow pathways, and fine-grained materials, which tend to impede groundwater flow. Because of mixed lithologies and the heterogeneous nature of this zone, groundwater flow direction and velocity will vary in response to specific site conditions. Groundwater is generally not observed in monitoring wells screened in deeper consolidated siltstone bedrock. Excavations within bedrock have exhibited very slow or no groundwater recharge. Groundwater is found perched on the bedrock surface during the rainy season.

Depth to groundwater in IA B is generally between 2 to 12 feet bgs. Because IA B is inland from the Mare Island Strait, tidal influence is not expected. Some tidal influence is expected, however, in monitoring wells located adjacent to Mare Island Strait in IA C1. Seventy-seven monitoring wells are located in IA C1. The depth to groundwater in the wells located in IA C1 range from 1 foot bgs to 23 feet bgs. Groundwater levels in most wells on Mare Island vary seasonally, with highest levels occurring in the wet season and lowest levels occurring in late summer.

Maps of the general piezometric surface of the aquifer within IA B and IA C1 during dry and wet seasons (based on groundwater levels recorded in October 2003 and April 2003, respectively) are shown in Figure 2.5-1. IA B straddles a bedrock ridge, which trends south-east to northwest along the axis of the island. This bedrock ridge causes a groundwater divide in IA B. Groundwater east of the divide travels toward Mare Island Strait, and groundwater west of the divide flows toward the wetlands to the west/southwest. The hydraulic gradient of the groundwater in IA B has an estimated range of 0.0008 to 0.01 foot/foot. Groundwater in IA C1 generally flows to the northeast, toward Mare Island Strait. The groundwater gradient in the IA C1 varies spatially and ranges from 0.004 to 0.014 foot per foot. The quay wall that is the barrier between IA C1 and the Strait is built upon concrete and wooden sheet piles that are driven into the subsurface. The quay wall is considered a permeable barrier due to numerous fractures and gaps. Therefore, the groundwater of the area and the waters of the Strait are hydraulically connected. The tidal variation in wells within 50 feet of the Strait shows that the groundwater under IA C1 and the surface water of Mare Island Strait are hydraulically well-connected (PRC 1996a). Figure 2.5-1 suggests that slight mounds and depressions are present on the groundwater surface in some areas of IA B and IA C1. These areas with relatively increased or decreased groundwater elevations are likely present as a result of localized changes in soil lithology.

2.5.3.1 Effects of Tidal Influence

Tidal fluctuations in Mare Island Strait are measurable in monitoring wells near the Strait but have minimal influence on groundwater flow rate and direction in areas of IA C1 set back from the Strait. Very near the Strait, tidal fluctuations can have a substantial influence on groundwater flow rate and direction. For example, during a 5-day period in 1995, wells approximately within 50 feet from the Strait exhibited tidal fluctuations of greater than 5 feet, while the Strait exhibited fluctuations of 6.9 feet (PRC 1996a). There is also some indication that proximity to utility corridors may increase the impact of the tide upon local groundwater variation. However, water levels at locations away from the Strait (further than 50 feet from the Strait) usually will not be impacted by the tide.

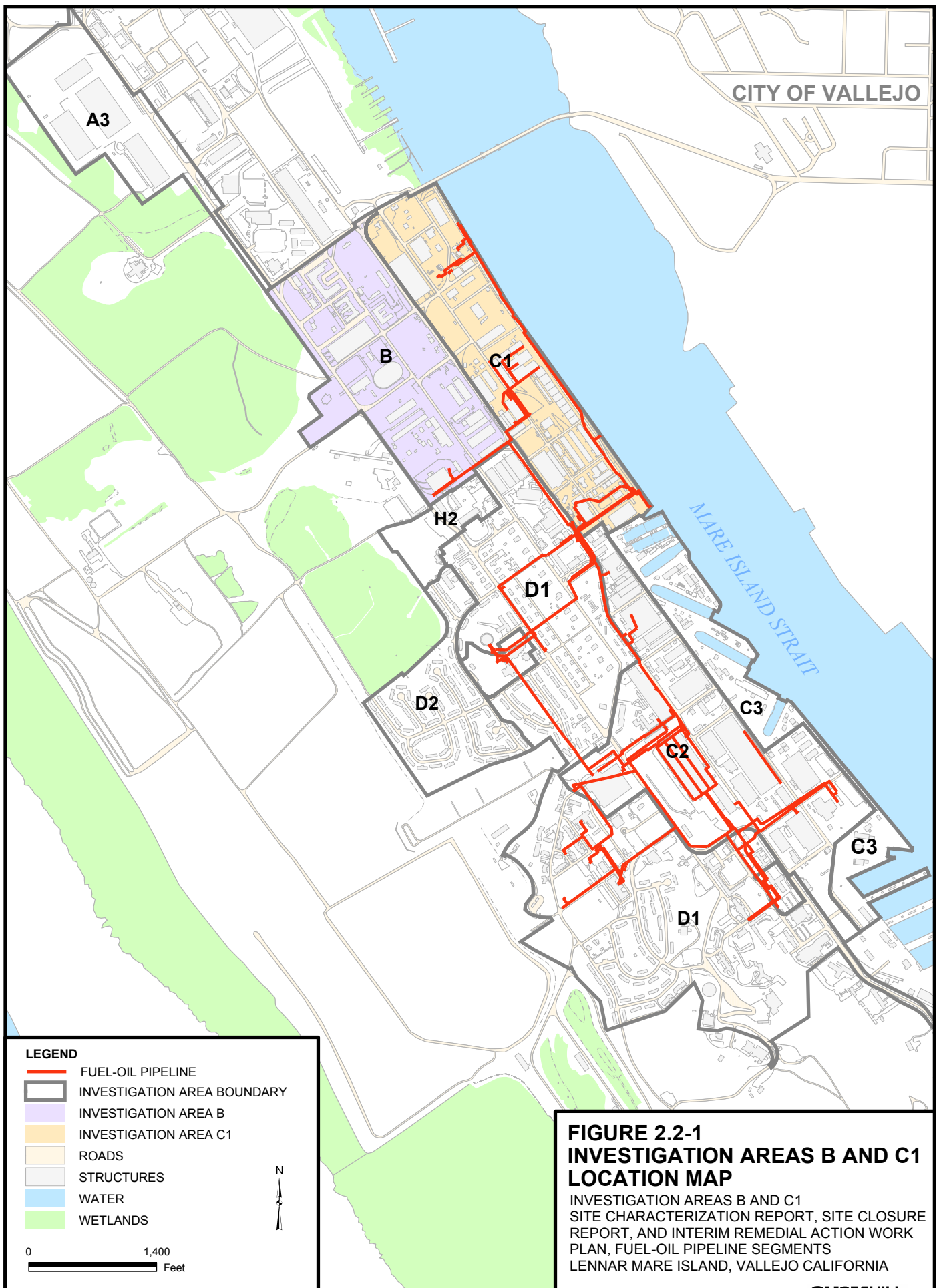
2.5.4 Climate

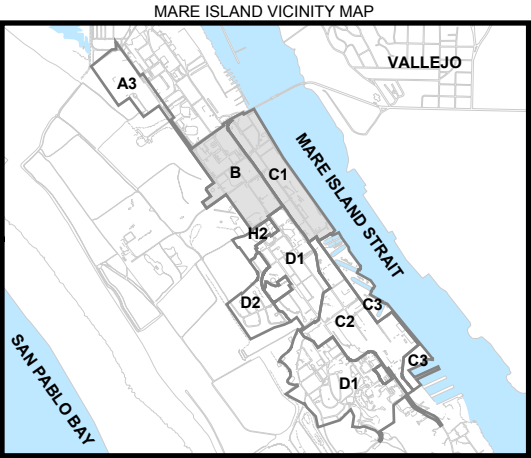
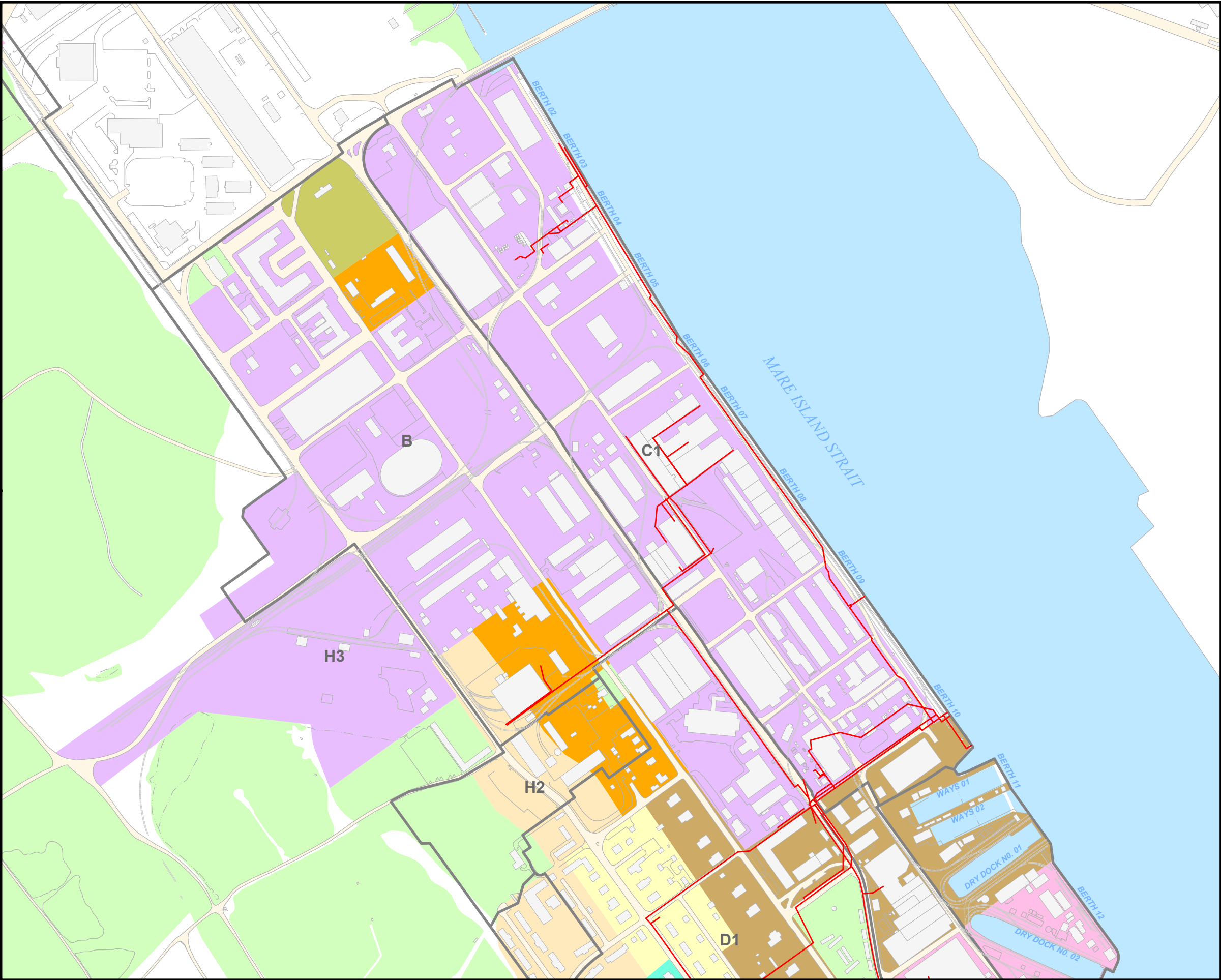
The climate of the North Bay area, including Mare Island, is generally warm and dry in summer and cool and wet in winter, with overall temperatures moderated by the proximity of San Francisco Bay. The average seasonal temperatures in the North Bay area, as recorded between 1970 and 2001 at the Martinez Pumping Station (4 miles southeast of Mare Island), range between 70 degrees Fahrenheit (°F) to 75°F in the summer and 45°F to 51°F in the winter (Western Regional Climate Service 2001).

Meteorological data were also recorded at the Mare Island industrial wastewater treatment plant (IWTP) between 1984 and 1990. These data are unpublished and documented in *Wastewater Monitoring Industrial Waste Water Treatment Plant (IWTP) Operation Summary Sheets Years 1990-1994* (TtEMI 1998a), *Meteorological Records Years 1984-1990 & 1992* (TtEMI 1998b), and *Daily Precipitation and Maximum Temperature Years 1970-1995* (TtEMI 1998c). Analysis of these meteorological data shows daily average air temperatures at the Mare Island IWTP at 58°F between 1984 and 1988. The average annual temperatures ranged from 49°F to 95°F in summer and 38°F to 74°F in winter for the same duration.

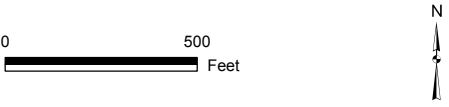
On average, precipitation in the North Bay area occurs 60 days per year, with an estimated 19.6 inches annually, as measured between 1970 and 2000 at the Martinez Pumping Station. Approximately 55 percent of total precipitation reportedly occurs in the winter months between December and February (Western Regional Climate Service 2001).

Daily average wind speeds measured at the Mare Island power plant were typically 5 to 10 knots to the south or west. Maximum velocities of 20 to 30 knots were often recorded, particularly during winter month, as described in the Mare Island Weather Statistics tables documented in the *Meteorological Records for Years 1984 to 1990* (MINS 1990).

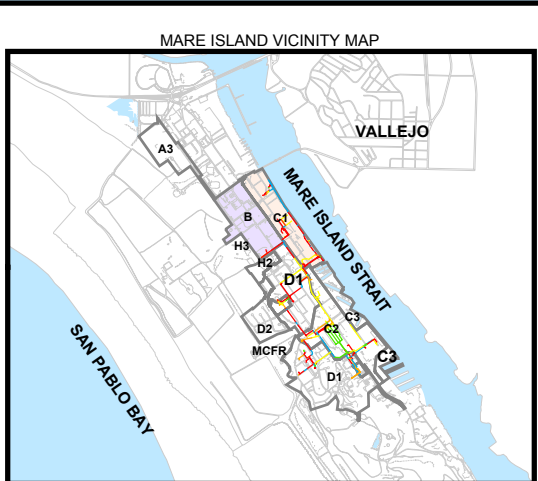
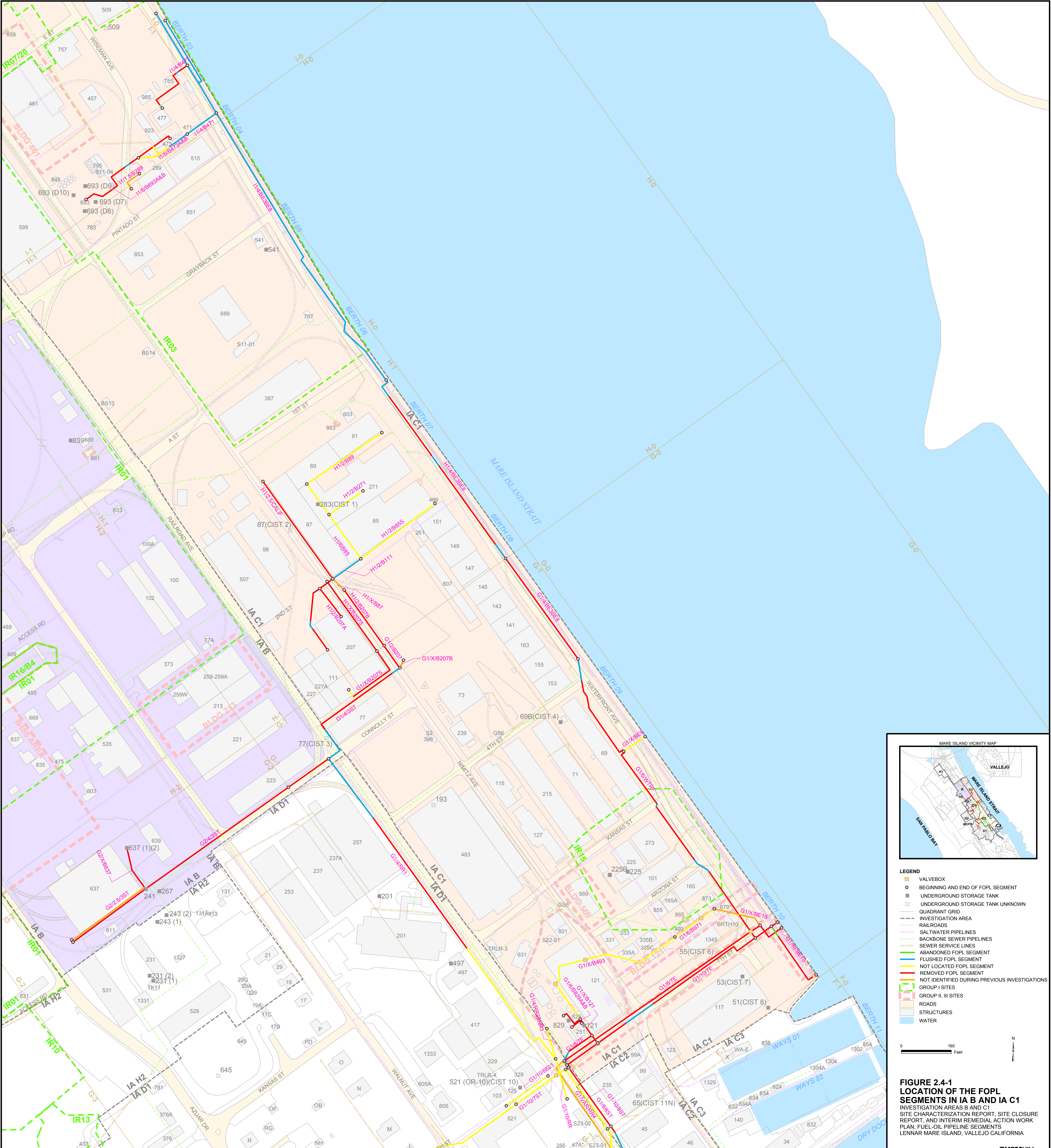




- LEGEND**
- FUEL-OIL PIPELINE
 - INVESTIGATION AREA
 - RAILROADS
 - ROADS
 - STRUCTURES
 - WATER
 - WETLANDS
 - EDUCATIONAL/CIVIC
 - LOW DENSITY
 - MEDIUM DENSITY
 - HIGH DENSITY
 - INDUSTRIAL
 - HISTORICAL CORE
 - MIXED-USE
 - PARKS
 - RETAIL



**FIGURE 2.2-2
FUTURE LAND USE**
INVESTIGATION AREAS B AND C1
SITE CHARACTERIZATION REPORT, SITE CLOSURE
REPORT, AND INTERIM REMEDIAL ACTION WORK
PLAN, FUEL-OIL PIPELINE SEGMENTS
LENNAR MARE ISLAND, VALLEJO CALIFORNIA



- LEGEND**
- VALVEBOX
 - BEGINNING AND END OF FOPL SEGMENT
 - UNDERGROUND STORAGE TANK
 - UNDERGROUND STORAGE TANK UNKNOWN
 - QUADRANT GRID
 - INVESTIGATION AREA
 - RAILROADS
 - SALTWATER PIPELINES
 - BACKBONE SEWER PIPELINES
 - SEWER SERVICE LINES
 - ABANDONED FOPL SEGMENT
 - FLUSHED FOPL SEGMENT
 - NOT LOCATED FOPL SEGMENT
 - REMOVED FOPL SEGMENT
 - NOT IDENTIFIED DURING PREVIOUS INVESTIGATIONS
 - GROUP I SITES
 - GROUP II, III SITES
 - ROADS
 - STRUCTURES
 - WATER

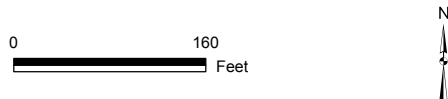


FIGURE 2.4-1
LOCATION OF THE FOPL
SEGMENTS IN IA B AND IA C1
INVESTIGATION AREAS B AND C1
SITE CHARACTERIZATION REPORT, SITE CLOSURE
REPORT, AND INTERIM REMEDIAL ACTION WORK
PLAN, FUEL-OIL PIPELINE SEGMENTS
LENNAR MARE ISLAND, VALLEJO CALIFORNIA

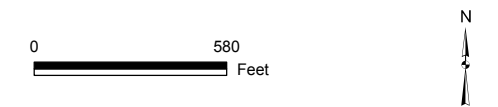
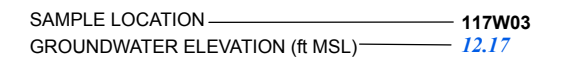
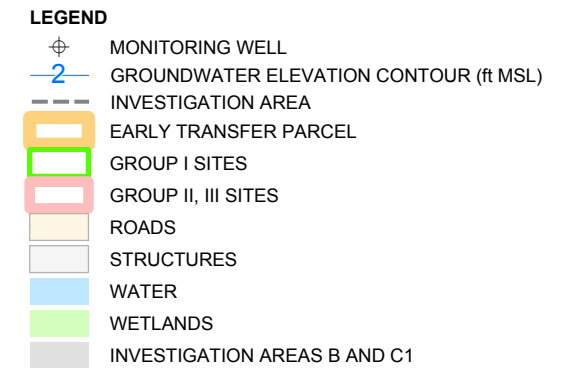
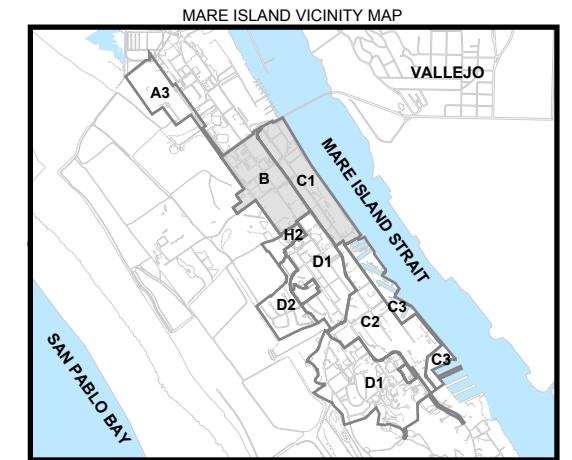
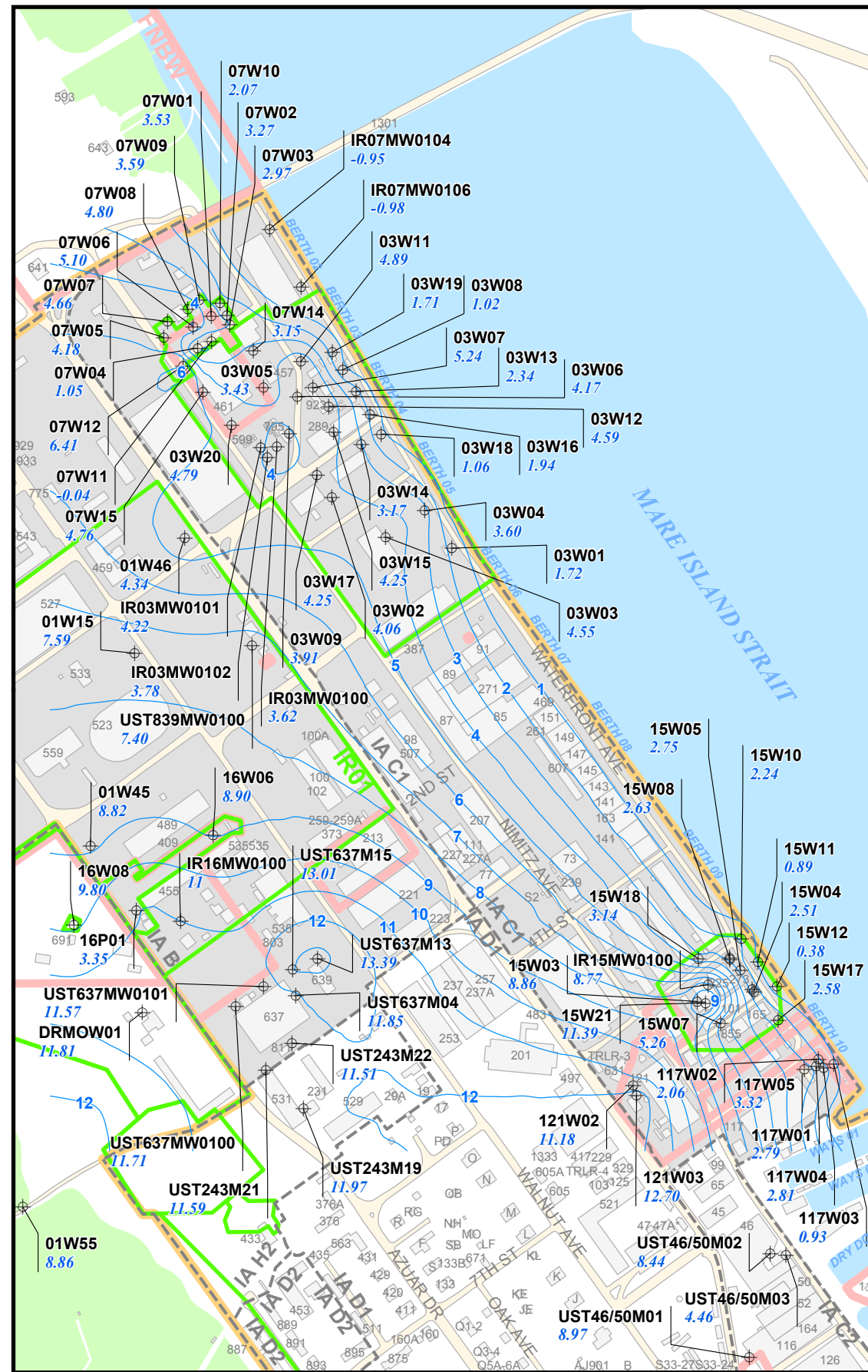
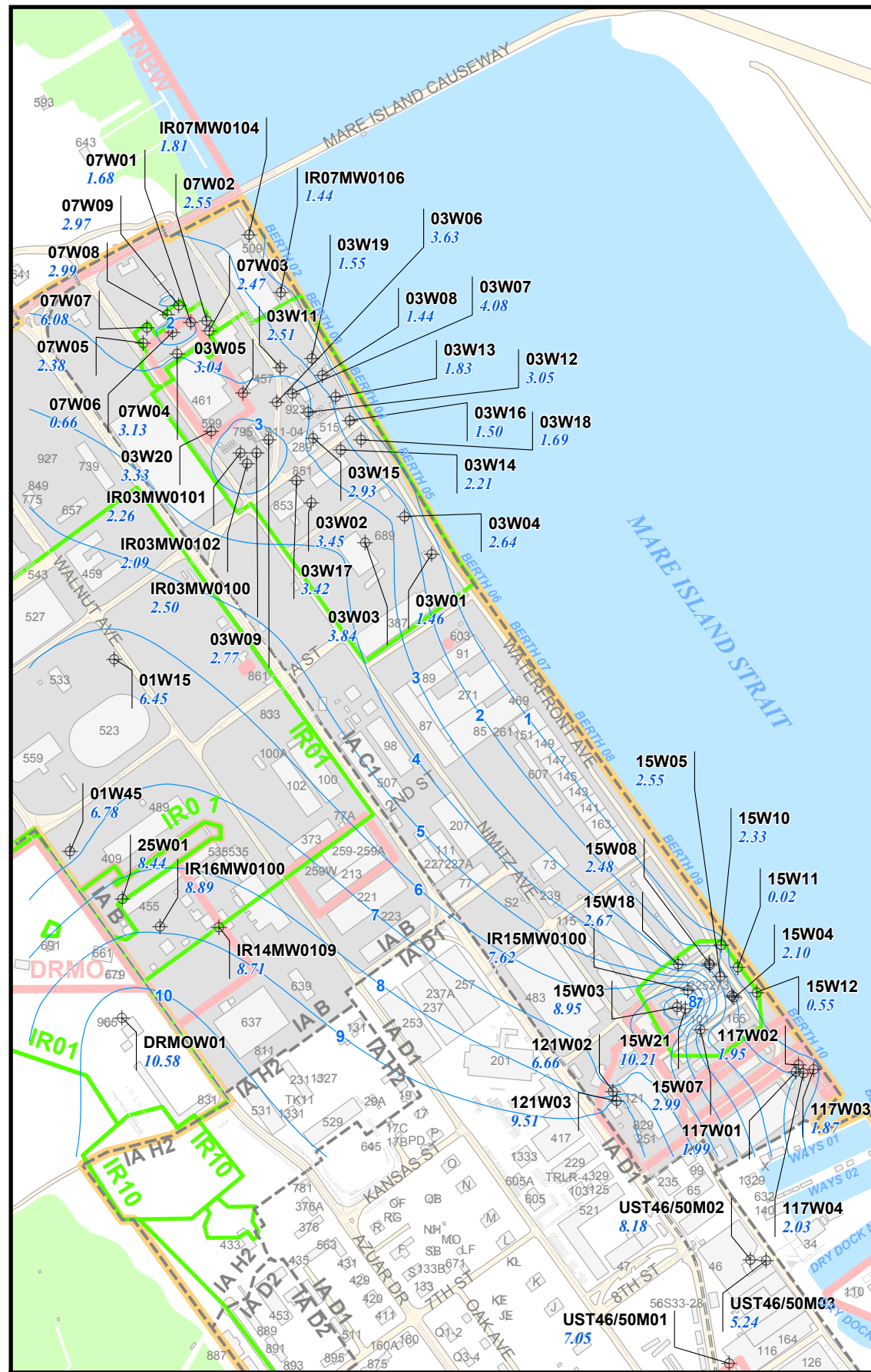


FIGURE 2.5-1
DRY AND WET
SEASON GROUNDWATER
ELEVATION CONTOURS
INVESTIGATION AREAS B AND C1
SITE CHARACTERIZATION REPORT, SITE CLOSURE
REPORT, AND INTERIM REMEDIAL ACTION WORK
PLAN, FUEL-OIL PIPELINE SEGMENTS
LENNAR MARE ISLAND, VALLEJO CALIFORNIA

3.0 Characterization of FOPL Segments within IA B and IA C1 Requiring No Further Action

This section presents site descriptions, summaries of previous investigations, and summaries of the 2002-2003 FOPL investigation for 1 FOPL segment in IA B and 21 FOPL segments in IA C1. The following FOPL segments included in this section were determined to be appropriate for permanent closure:

- G2/X/B637
- G1/8/8ST
- G1/8/7E
- G1/6/B829A&B
- G1/X/B121
- G1/X/B493
- G1/6/WTRF
- G1/X/BE9
- H1/4/BE3BE8
- G1/4/3ST
- G1/X/B207S
- G1/X/B207B
- H1/2/B207B
- H1/X/B207S
- H1/2/B111
- H1/X/B87
- H1/2/B207A
- H1/2.5/CALIF
- H1/2/B85S
- H1/2/B271
- I1/4/BE3BE8
- I1/4/B477

Of these 22 FOPL segments, the RWQCB has provided approval for closure of FOPL segments G2/X/B637, G1/8/7E, G1/6/B829A&B, I1/4/BE3BE8, and I1/4/B477 based on information provided in the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum, Mare Island Vallejo, California* (CH2M HILL 2002a, RWQCB 2004a).

3.1 FOPL Segment G2/X/B637

3.1.1 Site Description

FOPL segment G2/X/B637 is located in the southern portion of IA B, on the east side of Building 637, as presented in Figure 2.4-1. It is located in an area with a proposed residential land use (Figure 2.2-2). FOPL segment G2/X/B637 has a 2.5-inch diameter and approximately 145 feet long. The depth of this FOPL segment is unknown but was likely located at a depth of approximately 4 to 7 feet bgs (based on the depths of nearby FOPL segments). The pipeline segment previously connected UST 637-1 and UST 637-2 to FOPL segments G2/2.5/3ST and G2/4/3ST at the southeast corner of Building 637. RWQCB has concluded that no further action is required at FOPL segment G2/X/B637 based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2MHILL 2002a; RWQCB 2004a).

USTs 637-1 and 637-2 were both 16,000-gallon waste oil/diesel tanks installed in the 1940s, presumably to refuel locomotives at Building 637, the former locomotive repair facility and, later, the vehicle maintenance facility. These tanks were used for waste oil storage when the building use changed to vehicle maintenance. Closure of USTs 637-1 and 637-2 was proposed in *Draft Site Characterization and Removal Action Summary Report for Six Underground Storage Tanks in Investigation Area B* (CH2M HILL 2003c). This FOPL segment is located in an area with a surface elevation of 20 feet above msl. The nearest surface water is the wetlands area located approximately 1,200 feet west. The depth to groundwater is approximately 4 to 6 feet bgs. The local groundwater flow at the site is north to northeast (Figure 2.5-1). The site is located on native Mare Island soil.

3.1.2 Previous Actions and Investigations

Several investigations conducted at USTs 637-1 and 637-2 are relevant to FOPL segment G2/X/B637. The scope and key findings of these investigations are summarized here. In August 1990, USTs 637-1 and 637-2 were removed, and visibly contaminated soil was excavated. A strong odor, soil staining, and the presence of free product on the groundwater were observed. UST 637-1 was found full of waste oil, and UST 637-2 contained ABM and waste oil (Weston 2000). No holes were observed in either tank. Soil and groundwater samples were subsequently collected in 1997 to attempt to delineate the extent of contamination (TtEMI 1998d). Free product was noted in several probe holes. One boring (UST637M04) advanced during this investigation is located adjacent to FOPL segment G2/X/B637. Elevated concentrations of petroleum hydrocarbons were detected in soil during this investigation. The Navy consequently proposed additional excavation of contaminated soils at the site (TtEMI 1998d).

A second removal action was performed in 1999 in the area between Building 637 and Building 639 (Weston 2000). The approximate boundaries of the 1999 removal action are presented in Figure 3.1-1. Approximately 6,000 cubic yards (9,000 tons) of contaminated soil were removed and disposed of off site. This included the removal of FOPL segment G2/X/B637 and the soil that surrounded the segment. Contamination was observed as deep as 14 feet bgs and extending beneath Buildings 637 and 639 and under the sidewalk utility corridor to the south of the excavation. Three areas with petroleum hydrocarbon concentrations exceeding 1,000 milligrams per kilogram (mg/kg) on the excavation floor were further

excavated until visually clean conditions were encountered (Weston 2000), but additional confirmation samples were not collected at these spots.

Although confirmation samples indicated a significant reduction in petroleum hydrocarbon concentrations, seven of 13 confirmation samples collected from the excavation perimeter walls at 5 to 11 feet bgs contained petroleum hydrocarbons at concentrations exceeding 1,000 mg/kg (including samples UST637CS002, UST637CS008, UST637CS010, and UST637CS032, as shown in Figure 3.1-1). The areas with contamination along the sidewalls were not further excavated. The site was backfilled with clean imported soil, and the site was repaved.

In a letter report to the Navy, Tetra Tech Environmental Management, Inc. (TtEMI) concluded that the high sidewall soil concentrations were a smear zone of residual contamination due to product migration at the groundwater elevation, and that additional soil remediation would be impractical. TtEMI stated that the residual TPH-diesel concentrations are not expected to migrate and will naturally attenuate with time.

In 2002, an investigation was conducted at USTs 637-1 and 637-2 to determine the extent of groundwater contamination to the north through northwest of the site and the vertical extent of TPH-diesel contamination in soil beneath the excavated UST 637 Area. Sampling was conducted in June, August, and September 2002. Two borings (UST637GB0100 and UST637GB0101) were advanced within the former excavation; two wells (UST637MW0100 and UST637MW0101) were installed north of Building 637; and three existing monitoring wells (UST637M04, UST637M13, and UST637M15) were re-sampled. Soil and groundwater samples collected during this investigation were analyzed for TPH-diesel, TPH-motor-oil, and metals (CH2M HILL 2003c).

3.1.3 2002-2003 FOPL Investigation

Because FOPL segment G2/X/B637 and surrounding contaminated soil were removed during the 1999 removal action conducted at UST Sites 637-1 and 637-2 (Weston 2000), no additional sampling was necessary during implementation of the final FOPL SAP in 2002 and 2003.

3.1.4 Nature and Extent of Soil and Groundwater Contamination

Seven soil and two groundwater samples have been collected in the vicinity of FOPL segment G2/X/B637. While the extent of groundwater contamination has been defined at locations downgradient of the site, the lateral extent of soil contamination adjacent to the FOPL segment has not been defined due to the presence of Building 637 west of the FOPL. Analytical results for petroleum hydrocarbon, BTEX, and PAH compounds previously detected in the vicinity of these FOPL segments are presented in Figures 3.1-1, 3.1-2, and 3.1 3, respectively. Groundwater samples collected near and downgradient of FOPL segment G2/X/B637 have not been analyzed for BTEX or PAH compounds.

3.1.4.1 Nature and Extent of Soil Contamination

Figure 3.1-1 presents the analytical results for TPH-diesel and TPH-motor-oil in soil in the vicinity of FOPL segment G2/X/B637. Confirmation samples collected during the 1999 removal action indicated elevated concentrations of TPH-diesel were present at the excava-

tion bottom. Although the “hot spots” on the bottom were further excavated, no additional confirmation sampling was conducted (Weston 2000). Samples collected beneath the excavation area to assess the vertical extent of TPH-diesel contamination in 2002 did not contain TPH-diesel at concentrations greater than the Tier 1 ESLs (Figure 3.1-1). Therefore, these areas were adequately excavated during 1999. The vertical extent of contamination beneath the former USTs and FOPL segment G2/X/B637 has been defined.

Confirmation samples collected along the northern, eastern, southern, and western sidewalls of the excavation performed in 1999 quantified concentrations of TPH-diesel above Tier 1 ESLs. This contamination potentially continues beneath Buildings 637 and 639. Confirmation samples collected along the western sidewall are adjacent to the former location of FOPL segment G2/X/B637 and may be associated with previous releases from this FOPL segment. Confirmation samples collected from four locations along the western sidewall contained TPH-diesel at concentrations up to 1,900 mg/kg (at UST637CS002 at 5 feet bgs).

The sample collected from UST637CS002 contains TPH-diesel at a concentration exceeding the Tier 1 ESL (500 mg/kg). This sample was collected along the eastern side of Building 637. The presence of the building at this location prevents further excavation from being performed at this location. The extent of contamination in the western direction (beneath Building 637) is not defined.

Confirmation soil samples collected following the 1999 removal action were analyzed for BTEX and PAH compounds. Xylenes and various PAHs were detected (as presented in Figures 3.1-2 and 3.1-3) but at concentrations below the corresponding Tier 1 ESLs.

3.1.4.2 Nature and Extent of Groundwater Contamination

Groundwater samples have been collected from three locations adjacent to FOPL segment G1/X/B637 during investigations associated with USTs 637-1 and 637-2. In 1997, TPH-diesel and TPH-motor-oil were detected at maximum concentrations of 3,300 micrograms per liter ($\mu\text{g/L}$) and 500 $\mu\text{g/L}$, respectively, in a sample collected from UST637M04, which is located immediately east of Building 637. A sample collected from this same well in 2002 indicated that petroleum hydrocarbon concentrations had decreased; TPH-diesel was detected at a concentration of 1,600 $\mu\text{g/L}$ and TPH-motor-oil was not detected above analytical reporting limits. The TPH-diesel concentration is greater than the Tier 1 ESL (640 $\mu\text{g/L}$). Petroleum hydrocarbons were not detected above analytical reporting limits in grab groundwater samples collected from UST637GB0100 and UST637GB0101 in 2002 (Figure 3.1-1).

Groundwater samples collected from downgradient monitoring wells UST637MW0100 and UST637MW0101 (located north of Building 637) in 2002 did not contain TPH-diesel at concentrations exceeding analytical reporting limits, suggesting that groundwater contamination detected adjacent to the FOPL has stabilized and is not migrating downgradient of the FOPL segment and USTs. The extent of groundwater contamination has been defined.

3.1.5 Conclusions

FOPL segment G2/X/B637 is appropriate for permanent closure. The entire length of FOPL segment G2/X/B637 was removed. Therefore, any source of potential soil and groundwater contamination from these segments has been removed or remediated.

Elevated concentrations (exceeding Tier 1 ESLs) of TPH-diesel in soil and groundwater have been detected at locations immediately downgradient of FOPL segment G2/X/B637. Due to co-mingling of contamination and proximity of the FOPL and USTs 637-1 and 637-2, this contamination was addressed in conjunction with USTs 637-1 and 637-2 in *Draft Site Characterization and Removal Action Summary Report for Six Underground Storage Tanks in Investigation Area B* (CH2M HILL 2003c). A Tier 2 risk evaluation was performed for COPCs in this area; the results of this evaluation were presented in this previous report. Tier 2 screening levels of 2,300 mg/kg and 50,000 µg/L were developed for TPH-diesel in soil and groundwater, respectively. TPH-diesel was detected in soil and groundwater at FOPL segment G2/X/B637 at concentrations below Tier 2 screening levels, indicating that historical releases from FOPL segment G2/X/B637, UST 637-1, and UST 637-2 do not present a significant risk to human health or the environment and are not a threat to groundwater or surface water. The FOPL segment and USTs are low-risk fuel sites and are appropriate for permanent closure. This recommendation is consistent with the RWQCB conclusion that no further action is required at FOPL segment G2/X/B637 based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2M HILL 2002a; RWQCB 2004a). A recommendation for closure of USTs 637-1 and 637-2 was made in *Draft Site Characterization and Removal Action Summary Report for Six Underground Storage Tanks in Investigation Area B* (CH2M HILL 2003c).

3.2 FOPL Segments G1/8/8ST and G1/8/7E

3.2.1 Site Description

FOPL segments G1/8/8ST and G1/8/7E are located in areas with proposed mixed (industrial) land uses and areas proposed for historical preservation (Figure 2.2-2). FOPL segments G1/8/8ST and G1/8/7E have 8-inch diameters and approximately 235 feet and 151 feet long, respectively. FOPL segment G1/8/8ST is a continuation of FOPL segments F1/8/8ST and F2/8/8ST and intersects with FOPL segments G1/10/7ST and G1/8/7E at the valve box located near the intersection of Railroad Avenue and 7th Street (Figure 2.4-1). FOPL segment G1/8/7E extends from the valve box at the intersection of Railroad Avenue and 7th Street, to the southwest corner of Building 121, where it connects with FOPL segment G1/X/B121.

These FOPL segments are located in an area with a surface elevation of 18 to 19 feet msl. The depth of FOPL segments G1/8/8ST and G1/8/7E is estimated to be approximately 5 to 8 feet bgs. The depth to groundwater ranges from between 5 and 10 feet bgs, based on measurements in monitoring wells over 200 feet northwest of FOPL segments G1/8/8ST and G1/8/7E. Groundwater flows to the north-northeast (Figure 2.5-1), primarily in the upper fill/bay mud unit. These segments are located approximately 800 feet southeast of Mare Island Strait.

RWQCB has concluded that no further action is required at FOPL segment G1/8/7E based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2M HILL 2002a; RWQCB 2004a).

3.2.2 Previous Actions and Investigations

A field investigation was performed along FOPL segments G1/8/8ST and G1/8/7E from 1996 through 1998, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). All 235 feet of FOPL segment G1/8/8ST were removed during this investigation. Approximately 1 cubic yard of ABM was removed from an unspecified location along FOPL segment G1/8/8ST (Weston 2001). During this investigation, 96 feet of FOPL segment G1/8/7E were removed, and the remaining 55 feet were flushed. One soil sample (090) was collected following removal of FOPL segment G1/8/8ST, and one soil sample (078) was collected following removal of FOPL segment G1/8/7E.

Two soil samples were collected in the vicinity of FOPL segment G1/8/7E during a Phase II remedial investigation of IR14 in 1993. The soil samples were collected from vacuum excavation IR14VB406. Vacuum excavations were completed every 70 feet along the industrial wastewater pipelines in IA C1 (PRC 1996b). Soil samples were submitted for analysis of TPH-gasoline, TPH-diesel, TPH-motor-oil, BTEX, and metals. A groundwater sample was also collected from IR14VB046 and analyzed for TPH-diesel, TPH-motor-oil, and VOCs.

3.2.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL, additional field investigation and analytical data were required following the previous investigation to complete the characterization of contamination at FOPL segments G1/10/8ST and G1/8/7E. Two borings (FOPL8STGB0102 and FOPL8STGB0114) were advanced along FOPL segment G1/8/8ST during June and July 2003. Soil boring FOPL8STGB0102 was advanced 12.5 feet bgs. Soil samples were collected at 8.5 feet bgs and 10 feet bgs. Petroleum hydrocarbon staining and odor were observed from 7.5 to 9.5 feet bgs in this boring. No unusual visual or olfactory observations were noted below 9 feet bgs. Two soil samples were collected from FOPL8STGB0114 at 5 and 12 feet bgs. All samples were analyzed for TPH-diesel and TPH-motor-oil. The sample collected from 8.5 feet bgs at FOPL8STGB0102 was also analyzed for PAHs.

Because elevated concentrations of petroleum hydrocarbons were detected at FOPL8STGB0102 (as presented in the following section), an additional boring (FOPL8STGB0102A) was advanced east of the original boring location, as presented in Figure 3.2-1, during June 2003. One soil sample was collected at 8.5 feet bgs and analyzed for TPH-diesel and TPH-motor-oil. A groundwater sample was collected from a temporary polyvinyl chloride (PVC) well at this location to determine whether groundwater has been impacted by previous releases from the FOPL. The groundwater sample was analyzed for TPH-diesel, TPH-motor-oil, and PAHs. No unusual visual or olfactory observations were made during the drilling of this step-out boring, and organic vapors were not detected with a photoionization detector (PID).

One soil boring (FOPL7EBG0104) was advanced near the intersection of FOPL segments G1/6/7E and G1/8/7E in May 2003. Three attempts to advance borings at this location were made; however, all met refusal at approximately 5 to 7.5 feet bgs due to the presence of concrete. No unusual visual or olfactory observations were noted during the drilling. One soil sample was collected from 5 feet bgs and analyzed for TPH-diesel and TPH-motor-oil.

3.2.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbons, BTEX, and PAH contamination in soil and groundwater in the vicinity of FOPL segments G1/8/8ST and G1/8/7E have been defined largely by previous sampling efforts. Analytical results for petroleum hydrocarbon, BTEX, and PAH compounds previously detected in the vicinity of these FOPL segments are presented in Figures 3.2-1, 3.1-2, and 3.1-3, respectively. Ten soil samples and two groundwater samples have been collected along these FOPL segments.

3.2.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons were detected at generally low concentrations in the vicinity of FOPL segments G1/8/8ST and G1/8/7E, as shown in Figure 3.2-1. The only sample found to contain petroleum hydrocarbons at concentrations exceeding the Tier 1 ESL for industrial sites is the sample collected from 8.5 feet bgs at FOPL8STGB0102. This boring was advanced immediately downgradient of the central portion of FOPL segment G1/8/8ST. This sample contained TPH-diesel and TPH-motor-oil at concentrations of 740 mg/kg and 340 mg/kg, respectively. The concentration of TPH-diesel detected in this sample exceeds the Tier 1 ESL of 500 mg/kg for industrial soils.

BTEX compounds were not detected above laboratory reporting limits in the four samples for which they were analyzed, as shown in Figure 3.1-2. PAH compounds were detected at low concentrations in the one soil sample for which they were analyzed (Figure 3.1-3). All concentrations of PAH compounds were below the Tier 1 ESLs for industrial soils.

A Tier 2 risk analysis was performed based on the site-specific conditions of FOPL segment G1/8/8ST to derive a Tier 2 screening level for TPH-diesel. The methodology used to derive the Tier 2 screening levels is presented in Appendix D. The Tier 2 screening level for TPH-diesel in soil less than 10 feet bgs is 10,000 mg/kg, as presented in Table 1.4-3. TPH-diesel was detected in soil samples collected along this FOPL segment at concentrations significantly less than the Tier 2 screening level, suggesting that contamination at this site does not present a significant risk to human health or the environment.

3.2.4.2 Nature and Extent of Groundwater Contamination

A grab groundwater sample was collected at FOPL8STGB0102A during the investigation of FOPL segment G1/8/8ST in July 2003, as shown in Figures 3.1-3 and 3.2-1. The groundwater sample collected at FOPL8STGB0102A did not contain TPH-diesel, TPH-motor-oil, or PAH compounds at concentrations exceeding analytical reporting limits. The groundwater sample was not analyzed for BTEX compounds.

A groundwater sample (IR14VB406) was also collected in the vicinity of FOPL segment G1/8/7E in October 1993 as part of an investigation of IR14 (Figure 3.2-1). The groundwater sample collected at IR14VB406 contained TPH-diesel (as TRPH), TPH-motor-oil, and TPH-gasoline at maximum concentrations of 100,000 µg/L, 9,600 µg/L, and 18,000 µg/L respectively. Although these TPH constituents were detected at concentrations exceeding RWQCB Tier 1 ESLs, more recent analytical data for groundwater samples collected during 2002 at locations immediately downgradient from FOPL segment G1/8/7E indicate that concentrations of these constituents in groundwater are significantly lower than concentrations reported in 1993. TPH-diesel was detected in samples collected from B121GB0107A

and B121GB0111 at concentrations of 630 µg/L and 1,700 µg/L, respectively, as presented in Figure 3.2-1. TPH-motor-oil was not detected in the sample collected from B121GB0107A and was detected at a concentration of 820 µg/L in the sample collected from B121GB0111. These results are assumed to more accurately reflect the current groundwater conditions in the area. These samples were collected along FOPL segment G1/X/B121 (Figure 3.2-1) and were included in a Tier 2 risk analysis for FOPL segment G1/X/B121, as presented in Section 3.4, and are significantly below the Tier 2 screening level, which is 50,000 µg/L.

3.2.5 Conclusions

FOPL segments G1/8/8ST and G1/8/7E are appropriate for permanent closure. FOPL segments G1/8/8ST and G1/8/7E have been vacuum tested or removed. Following vacuum testing, the pipeline was flushed and capped with concrete plugs, which eliminates the possibility of residual petroleum hydrocarbons being released to the adjacent subsurface. Therefore, any source of potential soil and groundwater contamination from each of these FOPL segments has been removed or remediated.

These sites have been adequately characterized. Ten soil samples and two groundwater samples were collected along these FOPL segments, which are collectively 386 feet long. While the analytical data suggest that a release did occur to soil in the vicinity of FOPL segment G1/8/8ST, a Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) to evaluate the potential risk from TPH-diesel in soil. This analyte was detected in a sample collected along the FOPL segment at a concentration exceeding the Tier 1 ESL for industrial sites. TPH-diesel was detected at a concentration less than the corresponding Tier 2 screening level (10,000 mg/kg), which indicates that potential releases from FOPL segment G1/8/8ST do not present a significant risk to human health or the environment.

Petroleum hydrocarbons were detected in groundwater at FOPL segment G1/8/7E in 1993 at concentrations exceeding RWQCB Tier 1 ESLs. However, more recent analytical data for groundwater samples collected at locations immediately downgradient from FOPL segment G1/8/7E during 2002 indicate that concentrations of these constituents in groundwater are significantly lower than concentrations reported in 1993. Existing concentrations are below the Tier 2 screening levels derived for FOPL segment G1/X/B121 (Section 3.4).

Because concentrations of all constituents analyzed in recent soil and groundwater samples in the vicinity of FOPL segments G1/8/8ST and G1/8/7E are below the corresponding Tier 1 ESLs or Tier 2 screening levels, FOPL segments G1/8/8ST and G1/8/7E do not present a significant risk to human health or the environment. These sites are approximately 800 feet away from the closest surface water body. Low levels of petroleum hydrocarbons in soil and groundwater are not expected to impact surface water due to the immiscible nature of heavy, long-chained hydrocarbons. These segments are low-risk fuel sites and are appropriate for permanent closure. This recommendation is consistent with the RWQCB conclusion that no further action is required at FOPL segment G1/8/7E based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2M HILL 2002a; RWQCB 2004a).

3.3 FOPL Segment G1/6/B829A&B

3.3.1 Site Description

FOPL segment G1/6/B829A&B is located within the Building 121 IRP site (Figure 2.4-1). The Building 121 IRP site also includes two USTs and a Resin Regeneration Unit (RRU), which are discussed in separate documents. USTs 121 and 829 are discussed in detail in the *Investigation Area C1 UST Site Characterization Report* (CH2M HILL 2003g) and these USTs have been recommended for closure. The RRU is addressed in the *Investigation Area C1 Remedial Investigation Report* to be submitted in 2004.

This FOPL segment was previously discussed and recommended for closure in the *Draft Site Closure Summary Report for FOPL Segments G1/6/B829A&B, H1/2/B207B, I1/4/BE3BE8, and I1/4/B477 in Investigation Area C1* (CH2M HILL 2003h). Regulatory comments to this report have not been received. However, RWQCB has concluded that no further action is required at FOPL segment G1/6/B829A&B, based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2M HILL 2002a; RWQCB 2004a).

FOPL segment G1/6/B829A&B has a 6-inch diameter and is located in the southern portion of IA C1, approximately 780 feet southwest of the Mare Island Strait at 18 feet above msl. FOPL segment G1/6/B829A&B is 94 feet long. This FOPL segment connected UST 829 with FOPL segments G1/X/B493 and G1/X/B121. UST 829 had a capacity of 17,640 gallons and formerly supplied fuel to the power plant at Building 121 through the FOPL (SSPORTS 1996c). The bottom of this UST was at approximately 5 feet bgs, and the depth of the FOPL is expected to be no deeper than this. FOPL segment G1/6/B829A&B also connected UST 829 to former UST 121 (referred to as an oil/water separator [OWS]), which is located between Buildings 121 and 251. Figure 2.4-1 presents the location of the FOPL segments and former USTs 829 and 121. FOPL segment G1/6/B829A&B is located in an area with proposed future mixed (industrial) land use (Figure 2.2-2). Therefore, no upland habitat will develop in the future.

Cretaceous Panoche Formation bedrock is located at 2 to 8 feet bgs near FOPL segment G1/6/B829A&B. The depth to groundwater in the Building 121 Area ranges from between 5 and 10 feet bgs, based on measurements in monitoring wells located 160 feet northwest of FOPL segment G1/6/B829A&B. Groundwater flows primarily in the upper fill/bay mud unit to the north-northeast. However, this unit is less than 5 feet thick in some portions of the site (most notably near former UST 829), and therefore does not serve as a continuous aquifer unit in these areas. Groundwater is generally not observed within the shallow bedrock units and monitoring wells and excavation within bedrock have exhibited very slow or no groundwater charge.

3.3.2 Previous Actions and Investigations

A field investigation was performed along FOPL segment G1/6/B829A&B during 1996 and 1997, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). The entire length of this segment (94 feet) was removed during this investigation. No evidence of petroleum hydrocarbon contamination was noted during the removal of this segment.

UST 829 was removed in January 1996 (SSPORTS 1996c). Thirteen soil samples were collected along FOPL segment G1/6/B829A&B between 1996 and 1999 during site characterization activities associated with UST 829 to further define remaining TPH contamination (SSPORTS 1996c; TtEMI 1998e, 2000b, 2001b). Contaminated soil and bedrock in the vicinity of former USTs 121 and 829 and FOPL segment G1/6/B829A&B was over-excavated in 1999 to remove areas with high TPH concentrations. The 1999 removal action area is presented in Figure 3.2-1. The soil removal action excavated four soil sample locations along the FOPL, leaving eight representative soil samples for the FOPL segment G1/6/B829A&B area (see Figure 3.2-1). The over-excavation of contaminated material was terminated once highly impermeable bedrock was encountered. Groundwater seepage into the excavation was not observed at the site even though the excavation was left open for several months during the winter. No residual free product was observed during the removal effort.

3.3.3 2002-2003 FOPL Investigation

No additional site characterization work was performed as part of the 2002-2003 FOPL field investigation, as the site is already considered adequately characterized. RWQCB has concluded that no further action is required at FOPL segment G1/6/B829A&B, based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2MHILL 2002a; RWQCB 2004a).

3.3.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAHs contamination in the vicinity of FOPL segment G1/6/B829A&B were defined by sampling efforts performed during previous investigations (described in Section 3.3.2). Soil sample locations and results are presented in Figure 3.2-1. Eight soil samples have been collected in the vicinity of this FOPL segment. No groundwater samples were collected in the immediate vicinity of this FOPL segment.

3.3.4.1 Nature and Extent of Soil Contamination

The nature and extent of soil contamination for FOPL segment G1/6/B829A&B have been evaluated using all available data for soils remaining at the site (that have not been excavated by any removal actions). Figure 3.2-1 shows the sample locations relevant to FOPL segment G1/6/B829A&B and analytical results for petroleum hydrocarbon compounds in these samples.

After excavation and backfill of the site in 1999, the highest residual concentration of TPH-motor-oil and TPH-diesel associated with FOPL segment G1/6/B829A&B was 660 mg/kg and 370 mg/kg, respectively (both detected in a sample collected at 8 feet bgs at UST829S11FL). Because of the nature of the bedrock at the site, the lateral extent and depth of the high TPH concentrations are expected to be limited to a small area (TtEMI 2000b).

With the exception of a concentration of toluene (0.01 mg/kg) detected at SPRUST829-S-9-SW-1, BTEX compounds were not detected in any soil samples collected along FOPL segment G1/6/B829A&B. Phenanthrene was detected in a soil sample collected from SPRUST829-S-8-EW-1 at a concentration of 3 mg/kg. No other PAH compounds were detected in the soil samples collected at FOPL segment G1/6/B829A&B.

Residual concentrations of TPH, BTEX, and PAH remaining in soil at FOPL segment G1/6/B829A&B are not expected to pose an unacceptable risk in the future because these constituents are below the RWQCB Tier 1 ESLs for industrial sites (see Table 1.4-1) (RWQCB 2003).

3.3.5 Conclusions

FOPL segment G1/6/B829A&B is appropriate for permanent closure. The FOPL segment and surrounding soil has been removed. In addition, available information suggests that no releases occurred along this FOPL segment. Therefore, any source of potential soil and groundwater contamination from this FOPL segment has been removed.

The site has been adequately characterized, with eight soil samples (in non-excavated locations) being collected along the 94-foot-long FOPL segment. Soil samples in non-excavated areas collected near the location of this former segment did not contain elevated levels of TPH, BTEX, or PAH compounds (no concentrations exceeded Tier 1 ESLs [RWQCB 2003]). Although groundwater samples have not been collected along the FOPL segment, the siltstone/claystone bedrock is highly impermeable at the site and exhibits little to no groundwater flow. Further, heavy, long-chain fraction hydrocarbons are relatively insoluble. At the concentrations remaining in soils, these hydrocarbons are unlikely to be mobilized to groundwater, if there were significant groundwater flow. The nearest surface water body is located over 780 feet from FOPL segment G1/6/B829A&B, and is therefore, too far away to be impacted by immiscible long-chained hydrocarbons. Based on the analytical data and site conditions, this segment is not a threat to groundwater or surface water and presents no significant risk to human health or the environment. The FOPL segment is therefore a low-risk fuel site and is appropriate for permanent closure. This recommendation is consistent with the RWQCB conclusion that no further action is required at FOPL segment G1/6/B829A&B based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2M HILL 2002a; RWQCB 2004a).

3.4 FOPL Segment G1/X/B121

3.4.1 Site Description

FOPL segment G1/X/B121 is located within the Building 121 IRP site, in the southern portion of IA C1, approximately 780 feet southwest of the Mare Island Strait, on the southwest side of Building 121 (between Building 121 and Building 251) (see Figure 2.4-1). The FOPL segment is composed of a combination of 6-inch- and 10-inch-diameter pipeline (Weston 2001). The FOPL segment is approximately 120 feet long. This FOPL segment is located in an area with a surface elevation of 18 feet above msl. FOPL segment G1/X/B121 connected a former underground OWS (UST 121) to the valve box at FOPL segment G1/8/7E. FOPL segment G1/X/B121 also connected UST 121 to FOPL segment G1/6/B829A&B, which connected to UST 829. FOPL segment G1/X/B121 is located in an area with proposed future mixed (industrial) land use (Figure 2.2-2). Therefore, no upland habitat will develop in the future.

Cretaceous Panoche Formation bedrock is located at 2 to 8 feet bgs near FOPL segment G1/X/B121. The depth to groundwater in the Building 121 Area range from between 5 and

10 feet bgs, based on measurements in monitoring wells over 200 feet northwest of FOPL segment G1/X/B121. Groundwater flows to the north-northeast, primarily in the upper fill/bay mud unit. However, this unit is less than 5 feet thick in some portions of the site, and therefore does not serve as a continuous aquifer unit in the area.

3.4.2 Previous Actions and Investigations

In 1997, TtEMI collected samples in the vicinity of Building 121 for the preliminary assessment, site investigation, and remedial investigation for the Group II/III Sites (including Building 121) at Mare Island (TtEMI 2001b). Soil and groundwater samples were collected from soil boring location B121GB001 during this investigation and analyzed for TPH, BTEX, PAHs, and VOCs. These data are applicable to FOPL segment G1/X/B121 and are included in the figures and discussion associated with this site.

FOPL segment G1/X/B121 was removed during an investigation of the FOPL performed in 1998, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). Approximately 60 feet of 6-inch-diameter pipeline and 60 feet of 10-inch-diameter pipeline were removed during this investigation. UST 121 was removed simultaneous to removal of the FOPL (Weston 2001; TtEMI 2001b). After UST 121 and FOPL segment G1/X/B121 were removed, fuel-oil contamination was visible in the underlying bedrock. Samples of the bedrock were collected from a location below the former UST (at 8 feet bgs) and were analyzed for TPH and BTEX compounds. Elevated concentrations of petroleum hydrocarbons were detected in these samples (TtEMI 2001b).

As a result of the remaining visible contamination and the sample analysis results at the site, additional excavation activities were performed in 1999. The extent of the 1999 removal action is presented in Figure 3.2-1. Three feet of contaminated bedrock below the former UST 121 and FOPL segment G1/X/B121 were removed; however, additional inaccessible contaminated material was still observed at the bottom of the excavation. The excavation could not be safely deepened beyond 11 feet because Buildings 251 and 121 were located immediately adjacent to the excavation area, and additional digging would have undermined the building foundations. Because the excavation could not be extended safely without costly underpinning work to protect Building 251 and 121, the excavation was stopped at 11 feet and confirmation samples were collected at the base of the pit at each end of the former OWS location. These samples were analyzed for TPH-fuel-oil (1027-98 1A NORTH and 1028 2A SOUTH). The analytical data for samples 1027-98 1A NORTH and 1028 2A SOUTH were not validated and did not have the appropriate laboratory documentation; therefore, CH2M HILL collected replacement samples in 2002. Samples 1027-98 1A NORTH-CHM and 1028 2A SOUTH-CHM were collected in July 2002 and were analyzed for TPH-diesel and TPH-motor-oil.

Four additional borings (B121GB0111, B121GB0107, B121GB0107A, and UST121GB0100) were advanced in the vicinity of FOPL segment G1/X/B121 during 2002 and 2003 during implementation of the draft SAP for IA C1 (CH2M HILL 2002b) to improve the understanding of the conceptual site model and to support human health and ecological risk assessments for the Building 121 IRP site. Soil samples were collected from B121GB0111, B121GB0107, and B121GB0107A from 2 to 10.5 feet bgs and analyzed for TPH-diesel, TPH-motor-oil, BTEX, and PAHs. The soil sample from boring B121GB0111 was also analyzed for TPH-gasoline and VOCs. Groundwater samples were collected from borings

B121GB0111, B121GB0107A, UST 121GB0100, and downgradient boring B121GB0106. Samples collected from B121GB0111, B121GB0107A, and B121GB0106 were analyzed for TPH-diesel, TPH-motor-oil, and PAHs. Groundwater collected from boring UST121GB0100 was analyzed for BTEX and methyl tert-butyl ether (MTBE) to confirm the absence of these constituents at the site. Refusal was met at 12 feet bgs at two soil borings directly below former UST 121 (B121GB0111 and UST121GB0100) due to the presence of bedrock. No unusual visual or olfactory observations were made during drilling operations, and organic vapors were not detected with a PID.

3.4.3 2002-2003 FOPL Investigation

No additional site characterization work was performed as part of the 2002-2003 FOPL field investigation, as the site was adequately characterized by data collected during previous investigation of UST 121 and the Building 121 Area.

3.4.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of TPH, BTEX, and PAH contamination in the vicinity of FOPL segment G1/X/B121 were defined by sampling efforts performed during previous investigations of the FOPL (described in Section 3.4.2). The nature and extent of soil and groundwater contamination at FOPL segment G1/X/B121 have been evaluated using analytical data for nine soil and five groundwater samples collected in the vicinity of this segment.

3.4.4.1 Nature and Extent of Soil Contamination

Elevated concentrations of TPH-diesel, TPH-gasoline, and TPH-motor-oil were only detected in soil samples collected at one soil boring location (B121GB001) in 1997. Two soil samples collected from this boring contained TPH-diesel at a concentration exceeding the Tier 1 ESL, and one sample from this boring contained TPH-gasoline and TPH-motor-oil at concentrations exceeding the corresponding Tier 1 ESLs. Elevated concentrations of TPH-diesel were detected at 6 and 11 feet bgs at concentrations of 8,600 mg/kg and 1,500 mg/kg, respectively. The elevated concentrations of TPH-motor-oil and TPH-gasoline (3,400 mg/kg and 780 mg/kg, respectively) were detected in the sample collected from 6 feet bgs. The vertical extent of TPH-motor-oil and TPH-gasoline contamination at this location is defined by the sample collected at 11 feet bgs. Although TPH-diesel contamination at this location is not vertically defined, the analytical results indicate that concentrations are decreasing with depth. Because of the nature of the bedrock at the site, the lateral extent and depth of the high TPH concentrations are expected to be limited to a small area. Low concentrations of petroleum hydrocarbons (maximum of 250 mg/kg) were quantified in samples collected at the remaining borings along FOPL segment G1/X/B121.

Sampling conducted in 2002 indicated significantly reduced concentrations of petroleum hydrocarbons in soil beneath former UST 121 (1027-98 1A NORTH-CHM, 1028 2A SOUTH-CHM, B121GB0111). Although TPH-fuel-oil was detected at an elevated concentration (1,600 mg/kg) in a sample (1027-98 1A NORTH) collected in 1998, a sample collected subsequent to this sample (1027-98 1A NORTH-CHM in 2002) indicates that the 1998 data do not accurately represent current site conditions. In addition, the 1998 data are not validated laboratory data. The samples collected in 2002 indicate significantly lower

concentrations of petroleum hydrocarbons, with TPH-diesel and TPH-motor-oil detected at concentrations between nondetect and 99 mg/kg. The replacement data collected in 2002 were included in a Tier 2 risk analysis rather than the 1998 data, as the 2002 data are more recent and are validated analytical data.

Toluene, ethylbenzene, and xylenes were detected at low concentrations in soil samples associated with FOPL segment G1/X/B121 (Figure 3.1-2). Samples collected from B121GB001 contained the maximum concentrations of these compounds. All BTEX compounds were detected at concentrations below the corresponding Tier 1 ESLs. PAHs were not detected at elevated concentrations near FOPL segment G1/X/B121. The only PAH compounds detected in soil were benzo(a)anthracene (0.039 mg/kg at B121GB0111), chrysene (0.064 mg/kg at B121GB001 and 0.043 mg/kg at B121GB0111), dibenz(a,h)anthracene (0.12 mg/kg in B121GB0111), and fluoranthene (0.057 mg/kg at B121GB0111). All other analyzed soil samples had PAH values below the analytical reporting limit.

The COPCs in soil at FOPL segment G1/X/B121 are TPH-diesel, TPH-gasoline and TPH-motor-oil because they exceed the RWQCB shallow soil ESLs for industrial land use (500 mg/kg for TPH-diesel, 400 mg/kg for TPH-gasoline, and 1,000 mg/kg for TPH-motor-oil [RWQCB 2003]). A Tier 2 risk analysis was performed for FOPL segment G1/X/B121 in accordance with RWQCB guidance (RWQCB 2003) and based on the site-specific conditions of FOPL segment G1/X/B121 to derive Tier 2 screening levels for the COPCs. The methodology for deriving the Tier 2 screening levels is presented in Appendix D. The site-specific Tier 2 screening levels for COPCs in soil at FOPL segment G1/X/B121 range from 5,000 mg/kg to 10,000 mg/kg and are presented in Table 1.4-3. Residual concentrations of TPH remaining in soil at FOPL segment G1/X/B121 are significantly below the corresponding Tier 2 screening levels and are not expected to pose an unacceptable risk in the future.

3.4.4.2 Nature and Extent of Groundwater Contamination

Elevated concentrations of TPH-diesel and TPH-motor-oil were detected in groundwater samples associated with FOPL segment G1/X/B121. The maximum concentrations of TPH-diesel and TPH-motor-oil (50,000 and 41,000 µg/L, respectively) were detected in a 1997 grab groundwater sample collected at B121GB001. Two additional groundwater samples were collected near the site in 2002 at B121GB0111 and B121GB0107A that represent more recent groundwater conditions. The 2002 groundwater samples contained TPH-diesel at concentrations of 1,700 µg/L (B121GB0111) and 630 µg/L (B121GB0107A). TPH-motor-oil was detected in one of these two 2002 groundwater samples at a concentration of 820 µg/L (B121GB0111). Due to the availability of more recent groundwater data, the 1997 groundwater sample (B121GB001) is not considered representative of site conditions and was not used for the Tier 2 risk analysis for this site. A downgradient groundwater sample from B121GB0106 did not contain TPH-diesel and TPH-motor-oil at concentrations exceeding the analytical reporting limit, suggesting limited groundwater contamination migration associated with FOPL segment G1/X/B121 in this area. TPH-gasoline was not detected.

Xylene and acenaphthylene were the only BTEX and PAH compounds detected in groundwater samples associated with FOPL segment G1/X/B121. Each was detected in only one sample at low concentrations (0.2 µg/L xylene and 9.3 µg/L acenaphthylene in B121GB001).

TPH-diesel and TPH-motor-oil are considered groundwater COPCs for the site because they were detected at concentrations above the RWQCB Tier 1 ESLs for a non-drinking water resource (RWQCB 2003). A Tier 2 risk analysis was performed for groundwater associated with FOPL segment G1/X/B121 in accordance with RWQCB guidance (RWQCB 2003) and based on site-specific conditions. The Tier 2 screening level derived for TPH-diesel and TPH-motor-oil in groundwater at FOPL segment G1/X/B121 is 50,000 µg/L (see Table 1.4-4). TPH concentrations detected in groundwater at FOPL segment G1/X/B121 are significantly below this Tier 2 screening level.

3.4.5 Conclusions

FOPL segment G1/X/B121 is appropriate for permanent closure. The FOPL segment and surrounding soil has been removed. Therefore, any source of potential soil and groundwater contamination from this FOPL segment has been removed.

The site has been adequately characterized; nine soil samples (in non-excavated locations) and five groundwater samples are associated with this 120-foot FOPL segment. While the analytical data indicate that a release has occurred to soil and groundwater in the vicinity of FOPL segment G1/X/B121, COPCs (TPH-diesel, TPH-gasoline, and TPH-motor-oil in soil and TPH-diesel and TPH-motor-oil in groundwater) were detected at concentrations below site-specific Tier 2 screening levels (Tables 1.4-3 and 1.4-4). This indicates there is no significant risk to human health or the environment. Further, the siltstone/claystone bedrock exhibits little to no groundwater flow, and there are no drinking water wells or deeper drinking water aquifers at Mare Island. Therefore, there is a minimal threat to groundwater at the site. The nearest surface water body is located over 780 feet from FOPL segment G1/X/B121 and is too far away to be impacted by immiscible long-chained hydrocarbons. Therefore, FOPL segment G1/X/B121 is a low-risk fuel site and is appropriate for permanent closure.

3.5 FOPL Segment G1/X/B493

3.5.1 Site Description

FOPL segment G1/X/B493 is located in an area of IA C1 with proposed mixed (industrial) future land uses (Figure 2.2-2). The pipeline segment is 860 feet long and has varying diameters. Portions of FOPL segment G1/X/B493 are located beneath Building 121, which formerly served as a power plant. The eastern end of this pipeline connects with FOPL segment G1/6/B971 near Building 493, and the western end of this pipeline connects with FOPL segments G1/X/B121 and G1/6/B829A&B on the western side of Building 121 (Figure 2.4-1). The depth of this FOPL segment is unknown.

This FOPL segment is located in an area with a surface elevation of 15 to 17 feet msl. The depth to groundwater ranges between 5 and 10 feet bgs based on measurements in monitoring wells immediately upgradient of the western end of FOPL segment G1/X/B493. Groundwater flows to the north-northeast towards Mare Island Strait, primarily in the upper fill/Bay Mud unit (Figure 2.5-1). The FOPL segment is approximately 300 feet from Mare Island Strait.

3.5.2 Previous Actions and Investigations

No attempt has been made to locate this FOPL segment during previous investigations. However, soil samples have been collected in the vicinity of this FOPL segment during investigations of the Building 121 Area and the Berth 10 Area. In 1997, samples were collected in the vicinity of Building 121 as part of the preliminary assessment, site investigation, and remedial investigation of the Group II/III Sites (including Building 121) at Mare Island (TtEMI 2001b). In 1997, boring B121GB006 was advanced in the vicinity of FOPL segment G1/X/B493 during this investigation (Figure 3.2-1). Four soil samples were collected from this boring and subsequently analyzed for TPH-gasoline, TPH-diesel, TPH-motor-oil, VOCs, SVOCs, polychlorinated biphenyl (PCBs), and pesticides.

In 1998, soil and groundwater samples were collected in the vicinity of Berth 10 to investigate the extent of soil contamination and to evaluate the extent of impacts to groundwater that resulted from a release from the FOPL in 1991. TtEMI attempted to advance 23 direct-push borings and 13 vacuum excavation holes to investigate the fuel pipelines and Berth 10. Of these, BE10GB003 and BE10GB004 were advanced adjacent to FOPL segment G1/X/B493 (Figure 3.2-1). Two soil samples were collected from each of these borings and analyzed for TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX compounds (TtEMI 2001c).

3.5.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment G1/X/B493 were required following the previous investigations. A geophysical survey was performed in two areas of FOPL segment G1/X/B493 (immediately east of Building 121 and south of former Building 335A) during October 2002 in an attempt to locate FOPL segment G1/X/B493 using ground-penetrating radar (GPR) and metal-detection equipment. The results of the GPR survey are presented on Plates 28 and 29 in Appendix C. Utilities suspected of being the FOPL were identified during the survey. Consequently, a trench was advanced at one of the survey locations (south of former Building 335A) during June 2003. The trench was advanced to 14.5 feet bgs and advanced perpendicular to the expected orientation of the pipeline for a total length of approximately 15 feet. The width of the trench was 4 feet. The FOPL was not observed in the trench, suggesting that the FOPL is no longer present. However, petroleum hydrocarbon staining was observed in the trench at 10 to 14 feet bgs. Hydrocarbon staining was not observed at the base of the trench (14.5 feet bgs), indicating that the vertical extent of contamination was delineated. Soil samples were collected from the trench at 5 and 13.5 feet bgs. The sample collected from 13.5 feet bgs exhibited the greatest degree of contamination observed during trenching operations. The location of these samples (FOPLB493SS0100) is presented in Figure 3.2-1.

Four borings (FOPLB493GB0101A, FOPLB493GB0101B, FOPLB493GB0101C, and FOPLB493GB0101D) were advanced during July and August 2003 at locations down-gradient of the trench and along FOPL segment G1/X/B493 (Figure 3.2-1). One to two soil samples were collected from each boring from 13.5 to 20 feet bgs to laterally delineate the extent of the hydrocarbon staining observed in the trench. In addition, a groundwater sample was collected from FOPLB493GB0101A. Petroleum hydrocarbon odor and staining were detected at 18 feet bgs in FOPLB493GB0101C and at 20 to 23 feet bgs in FOPLB493GB0101D. Refusal was hit in these borings at depths of 18 feet bgs and 23 feet bgs,

respectively. Soil samples were collected from the visibly contaminated soil in both of these borings and analyzed for TPH-diesel, TPH-motor-oil, and PAHs.

An additional boring (FOPLB493GB0100) was advanced in July 2003. The purpose of this boring was to characterize soil contamination adjacent to the pipeline and to characterize groundwater downgradient of the portion of the FOPL segment that is present beneath and west of Building 121. The location of this boring was identified through collaboration with regulatory agencies and serves to address potential releases from the western end of this FOPL segment (beneath and west of Building 121) (CH2M HILL 2003a). The location of this boring is presented in Figure 3.2-1. Two soil samples and one groundwater sample were collected from this boring and submitted for analysis of TPH-diesel and TPH-motor-oil. The groundwater sample was also analyzed for PAHs. No indication of contamination was observed during drilling of FOPLB493GB0100.

3.5.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAH contamination in soil and groundwater in the vicinity of FOPL segment G1/X/B493 were generally defined by sampling efforts performed during investigations of the FOPL, the Building 121 Area, and the Berth 10 Area. Twenty-one soil samples and two groundwater samples were collected along FOPL segment G1/X/B493.

3.5.4.1 Nature and Extent of Soil Contamination

Analytical results for soil samples collected during 2003 along the portion of the pipeline that was formerly present east of Building 121 indicate that elevated concentrations of petroleum hydrocarbons are present at approximately 13.5 to 20 feet bgs. Staining was also observed in soil at these depths during trenching and drilling. The depth at which elevated concentrations of petroleum hydrocarbons were detected increases over lateral distances to the northeast. To illustrate, petroleum hydrocarbon staining and elevated concentrations of TPH-diesel and TPH-motor-oil (1,500 mg/kg and 1,300 mg/kg, respectively) were present in soil at 13.5 feet bgs in the trench (FOPLB493SS0100). Staining and elevated concentrations of TPH-diesel and TPH-motor-oil (7,400 mg/kg and 9,500 mg/kg, respectively) were present in soil 20 feet bgs in FOPLB493GB0101D, which is located approximately 60 feet northeast of the trench location. The TPH-diesel and TPH-motor-oil concentrations detected at FOPLB493GB0101D are the highest concentrations detected of these constituents at FOPL segment G1/X/B493.

Elevated concentrations of petroleum hydrocarbons were also detected at 16, 16, and 18 feet bgs in FOPLB493GB0101A, FOPLB493GB0101B, and FOPLB493GB0101C, respectively. Soil samples were collected at shallower depths (5 to 17 feet bgs) at FOPLB493SS0100, FOPLB493GB0101A, FOPLB493GB0101C, and FOPLB493GB0101D; elevated concentrations of petroleum hydrocarbons were not detected in these samples. Elevated concentrations of petroleum hydrocarbons were also not present in shallow soil samples collected west (at 1.5 to 9 feet bgs) of the trench from boring B121GB006. The analytical results for these samples are presented in Figure 3.2-1. Soil samples could not be collected below the samples with elevated concentrations of petroleum hydrocarbons because a very hard layer of silt and wood, through which the direct-push rig could not be advanced, was encountered at 18 and 23 feet bgs. Heavily stained soil was present on top of this impermeable material.

Although the vertical extent of contamination is not defined with analytical data, based on conditions encountered in the field, it appears that the hydrocarbon contamination is not penetrating the very hard material present at depths greater than 18 to 23 feet bgs.

Six soil samples collected from B121GB006, BE10GB003, and BE10GB004 were analyzed for BTEX compounds. The results of these analyses are presented in Figure 3.1-2. While BTEX compounds were detected in soil samples collected at 1.5, 6, and 9 feet bgs at B121GB006, no BTEX compounds were detected at concentrations exceeding the Tier 1 ESLs for industrial sites.

Eight soil samples collected from B121GB006, FOPLB493SS0100, FOPLB493GB0101B, FOPLB493GB0101C, and FOPLB493GB0101D were analyzed for PAHs. The results of these analyses are presented in Figure 3.1-3. Select PAHs were detected in each of these samples. PAHs were not detected at concentrations exceeding the appropriate Tier 1 ESLs for soil in industrial areas. Although benzo(a)pyrene was detected at concentrations exceeding the Tier 1 ESL for soil more shallow than 10 feet (0.13 mg/kg), the samples with the elevated concentrations of benzo(a)pyrene (FOPLB493GB0101C at 18 feet bgs and FOPLB493GB0101D at 20 feet bgs) were collected at depths greater than 10 feet. Consequently, the Tier 1 ESL for benzo(a)pyrene in soil greater than 10 feet bgs is an appropriate point of comparison for this data. The Tier 1 ESL for benzo(a)pyrene at this depth is 1.5 mg/kg. Benzo(a)pyrene was detected in these samples at concentrations of 0.13 and 0.16 mg/kg.

A Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) and based on the site-specific conditions of FOPL segment G1/X/B493. The purpose of the analysis was to derive Tier 2 screening levels for analytes that were detected at concentrations exceeding Tier 1 ESLs. The methodology for deriving the Tier 2 screening levels is provided in Appendix D. The Tier 2 screening levels for TPH-diesel and TPH-motor-oil in soil greater than 10 feet bgs are 10,000 mg/kg, as presented in Table 1.4-3. All constituents in samples collected along this FOPL segment were detected at concentrations less than the corresponding Tier 2 screening level, suggesting that contamination at this site does not present a significant risk to human health or the environment.

3.5.4.2 Nature and Extent of Groundwater Contamination

Two groundwater samples have been collected along FOPL segment G1/X/B493. The groundwater sample collected from FOPLB493GB0101A in July 2003 contained TPH-diesel and TPH-motor-oil at concentrations of 710 µg/L and 730 µg/L, respectively. These concentrations slightly exceed the Tier 1 ESL for these constituents (640 µg/L). Petroleum hydrocarbon staining was observed in soil in the vicinity of FOPLB493GB0101A. Petroleum hydrocarbons were not detected in the groundwater sample collected from FOPLB493GB0100. This result suggests that potential previous releases from the western end of FOPL segment G1/X/B493 did not result in an impact to groundwater. PAHs were not detected in either of the groundwater samples collected along FOPL segment G1/X/B493. The groundwater samples were not analyzed for BTEX compounds.

A Tier 2 risk analysis was performed, based on the site-specific conditions of FOPL segment G1/X/B493, to derive Tier 2 screening levels for analytes that were detected in groundwater at concentrations exceeding Tier 1 ESLs. The methodology for deriving the Tier 2 screening

levels is presented in Appendix D. The Tier 2 screening level for TPH-diesel and TPH-motor-oil in groundwater is 50,000 µg/L, as presented in Table 1.4-4. TPH-diesel and TPH-motor-oil were detected at concentrations significantly less than the corresponding Tier 2 screening level, suggesting that groundwater contamination at this site does not present a significant risk to human health or the environment.

3.5.5 Conclusions

FOPL segment G1/X/B493 is appropriate for permanent closure. The results of exploratory trenching along the FOPL segment indicate that this segment no longer exists. Therefore, any source of potential soil and groundwater contamination from these segments has been removed.

The site has been adequately characterized. Twenty-one soil samples and two groundwater samples were collected along this 860-foot segment. While the analytical data suggest that a release did occur to soil and groundwater in the vicinity of this FOPL segment, a Tier 2 risk analysis was performed to evaluate the potential risk from TPH-diesel and TPH-motor-oil in soil and groundwater. These analytes were detected in samples collected along the segment at concentrations exceeding Tier 1 ESLs for industrial sites. The Tier 2 screening levels for soil and groundwater are presented in Tables 1.4-3 and Table 1.4-4, respectively. All constituents were detected at concentrations less than the corresponding Tier 2 screening level, which indicates that FOPL segment G1/X/B493 does not present a significant risk to human health or the environment and does not pose a threat to groundwater or surface water. The nearest surface water body (Mare Island Strait) is located approximately 300 feet from the FOPL segment G1/X/B493, which is too far away to be impacted by immiscible long-chained hydrocarbons. The FOPL segment is a low-risk fuel site and is appropriate for permanent closure.

3.6 FOPL Segment G1/6/WTRF

3.6.1 Site Description

FOPL segment G1/6/WTRF has 6-inch diameter and extends along the waterfront from FOPL segment G1/10/7E (located at Berth 10) to FOPL segment G1/4/BE3BE8 (located at Berth 8) (Figure 2.4-1). The segment is located in IA C1 in an area with a proposed mixed (industrial) land use (Figure 2.2-2). This FOPL segment is approximately 1,211 feet long and is buried at approximately 2 to 4 feet bgs. Groundwater is located at approximately 7 to 8 feet bgs and flows to the northeast towards Mare Island Strait (Figure 2.5-1). The FOPL segment is located approximately 85 feet away from the Strait. This FOPL segment is located in an area with a surface elevation of 9 to 10 feet above msl.

3.6.2 Previous Actions and Investigations

A field investigation was performed along this FOPL segment during 1997, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). A total of 1,086 feet of this FOPL segment were removed and 125 feet were flushed and left in place to avoid disruption to railroad tracks. Prior to flushing, the pipeline passed a vacuum test. Eight soil samples (049, 050, 050A, 051, 052, 053, 054, and 054A) were collected at six locations along the removed portion of this FOPL segment at a depths ranging from 2 to 5 feet bgs. These

sample locations are presented in Figure 3.2-1. Based on information provided in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001), it is concluded that samples 050A and 054A were collected following over-excavation at sample locations 050 and 054, respectively.

Analytical data collected during field investigations of IR15 and the Berth 10 Area are also used in the evaluation of nature and extent of contamination at FOPL segment G1/6/WTRF. The following sections summarize the investigations that were performed at IR15 and the Berth 10 Area that pertain FOPL segment G1/6/WTRF.

3.6.2.1 IR15

In 1988, eight soil borings were advanced in the vicinity of Building 225 to characterize soil and groundwater contamination at IR15. Five of the eight borings were completed as monitoring wells (15W02, 15W03, 15W05, 15W07, and 15W09). Of these monitoring wells, 15W05 is located adjacent to FOPL segment G1/6/WTRF. Based on detected concentrations of total chromium and hexavalent chromium in groundwater, it was recommended that a Phase I remedial investigation be conducted at IR15 to facilitate the development of a remedial action plan to remediate the site (L&W 1988).

A site characterization study report was generated in 1991 and finalized in 1992 (IT 1992). It presented the results of Phase I of the remedial investigation conducted for Mare Island. The objective of the Phase I remedial investigation conducted at IR15 was to assess the extent of TPH and metals contamination in soil and groundwater at the site. Eight soil borings, four of which were completed as monitoring wells (15-SB02IT, 15-SB04IT, 15-SB05IT, 15-SB06IT, 15W01, 15W04, 15W06, and 15W08), were drilled up to 30 feet bgs in the vicinity of Building 225. Of these borings, the boring completed as monitoring well 15W04 is located adjacent to FOPL segment G1/6/WTRF. Soil samples were collected from this boring at 3.5, 6, 8, and 12.5 feet bgs and analyzed for TPH-diesel. Groundwater samples were collected following well completion and during subsequent quarterly groundwater monitoring events.

PRC prepared the draft remedial investigation report for Operable Unit 3 in 1996, which presented the results of Phase II of the remedial investigation. The Phase II remedial investigation for IR15 was performed in two stages. The first stage of investigation took place between 1993 and 1995. Fourteen direct-push borings (15GB001 through 15GB009, 15GB011, 15GB012, and 15GB014 through 15GB016) were advanced from 2.5 to 17 feet bgs. Of these borings, 15GB005 is located adjacent to FOPL segment G1/6/WTRF. Samples were collected from this boring at 2.5 feet bgs and analyzed for TPH-diesel, TPH-motor-oil, VOCs, PCBs, and metals. Five vacuum excavation borings (15VB007, 15VB008, 15VB010, 15VB011, and 15VB013) were completed in November 1993 from approximately 6 to 16.5 feet bgs. These vacuum excavation borings were installed to investigate potential soil contamination adjacent to the following underground utility corridors: the industrial wastewater lines, the sanitary sewer pipelines, the stormwater pipelines, and the cooling water loop. Of these vacuum excavations, IR15VB008 and IR15VB011 were advanced adjacent to FOPL segment G1/6/WTRF. Two soil samples were collected from each of these vacuum excavations and analyzed for TPH-gasoline, TPH-diesel, TPH-motor-oil, BTEX compounds, PCBs, and metals. A groundwater sample was also collected from IR15VB011.

In August 1994 and January and February 1995, eight additional groundwater monitoring wells were installed at IR15 to further evaluate groundwater conditions in both the shallow water-bearing zone and in the weathered bedrock. Well locations were selected based on the results of analyses of soil and groundwater samples collected during the direct-push sampling and during previous investigations. Four wells (15W10 through 15W12 and 15W17) were completed from 15 to 20 feet bgs. Four wells (15W04B, 15W08B, 15W18, and 15W19) were completed to 20 to 40 feet bgs and were screened entirely within the bedrock. Of these monitoring wells, 15W04B, 15W08B, 15W10, and 15W17 were advanced adjacent to FOPL segment G1/6/WTRF. Three to six soil samples were collected from each of these borings and analyzed for TPH-diesel, TPH-motor-oil, VOCs, PCBs, pesticides, metals, and cyanide. Groundwater samples were collected following well completion and during subsequent quarterly groundwater monitoring events.

3.6.2.2 Berth 10 Area

Forty-three soil borings were drilled or probed in the Berth 10 Area during two separate sampling events in 1991 and 1993 to assess the extent of contamination in soil and groundwater associated with the June 1991 fuel spill (see Section 4.2.2). Of these 43 soil borings, BE10SB004, BE10SB012, BE10SB015, BE10SB021, BE10SB031, and BE10SB037 were advanced adjacent to FOPL segment G1/6/WTRF. Soil samples were analyzed for TPH-motor-oil and/or TPH-diesel. Sixteen samples from six soil borings were analyzed for BTEX during the second sampling event (PRC 1996c). The analytical data from these investigations indicated that fuel oil released during tightness testing in 1991 had migrated through the subsurface at the interface with the water table rather than through the vadose zone.

An investigation of soil and groundwater in the vicinity of Berth 10 was conducted in 1998 and 1999 to investigate the extent of contamination associated with portions of the FOPL and to evaluate the extent of impacts to groundwater that resulted from the 1991 release from the FOPL. An attempt was made to advance 23 borings (borings BE10GB006 and BE10GB016 met refusal near the ground surface and were not logged) and 13 vacuum excavation holes to further characterize contamination associated with historical releases from the FOPL in the Berth 10 Area. Of these, BE10GB008, BE10GB009, BE10GB010, BE10GB018, and BE10VB010 were advanced adjacent to FOPL segment G1/6/WTRF. All soil samples were analyzed for TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX (TtEMI 2001c).

3.6.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment G1/6/WTRF was required following the previous investigations. Eight borings (FOPLWTRFGB0100 through FOPLWTRFGB0105, FOPLWTRFGB0106A, and FOPLWTRFMW0100) were advanced along or downgradient of FOPL segment G1/6/WTRF during May, June, and October 2003. One boring (FOPLWTRFMW0100) was completed as a monitoring well. With exception to FOPLWTRFMW0100 and FOPLWTRFGB0106A, one to two soil samples were collected at each boring location at depths below the former FOPL location (3 to 7 feet bgs). Soil samples were analyzed for TPH-diesel and TPH-motor-oil. FOPLWTRFGB0106A was located directly downgradient of

previous sample location 054 but could not be advanced to a depth greater than 4 feet bgs during two attempts at drilling due to the presence of concrete at this depth. Consequently, soil samples were not collected from this boring. A groundwater sample was collected from FOPLWTRFMW0100 following completion and development of this groundwater monitoring well on August 13, 2003. No unusual visual or olfactory observations were made during drilling operations, and organic vapors were not detected with a PID.

3.6.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAH contamination in soil in the vicinity of FOPL segment G1/6/WTRF were defined by sampling efforts performed during investigations of the FOPL, Berth 10, and IR15. Sixty-eight soil and 29 groundwater samples were collected along FOPL segment G1/6/WTRF at locations presented in Figure 3.2-1.

3.6.4.1 Nature and Extent of Soil Contamination

With exception to elevated concentrations of TPH-diesel and TPH-fuel-oil in sample 054A (located near the northern end of FOPL segment G1/6/WTRF) and elevated concentrations of TPH-diesel in samples collected at BE10GB010, BE10SB004, BE10SB015, and BE10SB021 (located near the southern end of FOPL segment G1/6/WTRF), low petroleum hydrocarbon concentrations have been detected in soil along FOPL segment G1/6/WTRF. The analytical results from previous sampling efforts are presented in Figure 3.2-1. Soil contamination appears to be limited to these two areas along the pipeline. TPH-diesel was previously detected in sample 050 at a concentration of 16,000 mg/kg, but analytical data for samples collected during 1997, 1998, and 2003 (from 050A, BE10GB008, and FOPLWTRFGB0100, respectively) following excavation of soil at this location indicate that contamination is no longer present at this location.

TPH-diesel was detected at a concentration of 1,100 mg/kg, and TPH-fuel-oil was detected at a concentration of 1,400 mg/kg in sample 054A. This sample was collected at 4 feet bgs at a bend in the removed portion of the segment. Although the vertical extent of contamination is not defined at this location, the lateral extent of contamination along the pipeline is defined by samples collected from FOPLWTRFGB0101 and FOPLWTRFGB0105 (Figure 3.2-1).

Samples collected near the southern end of the FOPL segment and in the vicinity of FOPL segments G1/6/7E and G1/10/7E contained TPH-diesel at concentrations up to 2,600 mg/kg in samples collected at 8 feet bgs. The maximum concentration was detected in BE10SB004. TPH-fuel-oil was only detected at a concentration exceeding the Tier 1 ESL at BE10GB010. TPH-fuel-oil was detected at a concentration of 2,300 mg/kg in a sample collected from this boring at 11.5 feet bgs. Elevated concentrations of TPH-diesel and TPH-fuel-oil detected near the southern end of this FOPL segment are laterally but not vertically delineated. The remaining soil samples collected along FOPL segment G1/6/WTRF contained petroleum hydrocarbons at concentrations below Tier 1 ESLs.

Forty-one soil samples collected during previous investigations were analyzed for BTEX compounds. BTEX compounds were not detected above analytical reporting limits in any of these samples. Eleven soil samples collected during previous investigations were analyzed for PAHs. Select PAHs were detected in samples 050, 052, 054, and 054A. The analytical

results for these samples are presented in Figure 3.1-3. All PAHs were detected at concentrations below the corresponding Tier 1 ESL for industrial sites.

A Tier 2 risk analysis was performed based on the site-specific conditions of FOPL segment G1/6/WTRF to derive Tier 2 screening levels for analytes that were detected at concentrations exceeding Tier 1 ESLs along this FOPL segment. The COPCs for this FOPL segment are TPH-diesel and TPH-fuel-oil. The methodology used in the Tier 2 risk analysis is presented in Appendix D. The Tier 2 screening level for TPH-diesel and TPH-fuel-oil in soil is 10,000 mg/kg (Table 1.4-3). The EPCs for TPH-diesel and TPH-fuel-oil do not exceed this Tier 2 screening level.

3.6.4.2 Nature and Extent of Groundwater Contamination

Twenty-nine groundwater samples have been collected adjacent to or downgradient of FOPL segment G1/6/WTRF since 1997. Elevated petroleum hydrocarbon concentrations were detected in samples collected at 15W04B, 15W05, 15W10, 15W17, BE10GB009, and BE10GB010. The greatest concentrations of TPH-diesel and TPH-motor-oil (up to 2,500 and 3,400 µg/L, respectively) were detected in samples collected from 15W17 in 1998 and 1999. More recent samples have not been collected from this monitoring well. The greatest concentrations of TPH-fuel-oil (690 to 800 µg/L) were detected in grab groundwater samples collected from borings BE10GB009 and BE10GB010 in 1998. Monitoring well FOPLWTRFMW0100 is positioned downgradient of BE10GB009. Analytical data from this well are considered more representative of existing groundwater conditions at the Strait than data from the 1998 grab samples because: (1) the monitoring well is located downgradient of the grab groundwater sample locations and is closer to the Strait; (2) samples collected from the monitoring well were collected in 2003, while samples collected from BE10GB009 and BE10GB010 were collected in 1998; and (3) unfiltered grab groundwater samples from BE10GB009 and BE10GB010 potentially contain soil particulate matter that can bias petroleum hydrocarbon concentrations in groundwater high.

TPH-gasoline was detected at a maximum concentration of 2,900 µg/L in 15W05 in 1999. TPH-gasoline was also detected at a concentration of 580 µg/L in 15W10 in 1997. Groundwater samples collected from this well in 1998 and 1999 did not contain elevated concentrations of TPH-gasoline. Monitoring well 15W05 is located downgradient of IR15. Elevated concentrations of TPH-gasoline in groundwater at this location are likely attributed to volatile chlorinated compounds present in groundwater as a result of previous releases from IR15. TPH-gasoline in groundwater at this location is addressed with IR15 in the *Draft Remedial Investigation Report for Investigation Area C1* to be submitted in 2004. TPH-gasoline is not considered a COPC associated with previous releases from the FOPL.

Benzene, toluene, and xylenes were each detected above analytical reporting limits in one to two groundwater samples. These analytes were detected at maximum concentrations of 0.8, 0.3, and 0.8 µg/L, respectively, in groundwater samples collected near FOPL segment G1/6/WTRF (Figure 3.1-2). These results are all below the corresponding Tier 1 ESL. Sixteen groundwater samples were analyzed for PAHs. Acenaphthene is the only PAH to be detected in any of these samples (Figure 3.1-3). This PAH was detected in a groundwater sample collected at FOPLWTRFMW0100 in 2003 at a concentration of 15 µg/L, which is below the Tier 1 ESL.

A Tier 2 risk analysis was performed based on the site-specific conditions of FOPL segment G1/6/WTRF to derive Tier 2 screening levels for analytes that were detected at concentrations exceeding Tier 1 ESLs along this FOPL segment. The methodology used to derive the Tier 2 screening levels is presented in Appendix D. The Tier 2 screening level for TPH-diesel, TPH-fuel-oil, and TPH-motor-oil in groundwater is 50,000 µg/L (Table 1.4-4). COPCs were detected in groundwater at FOPL segment G1/6/WTRF at concentrations that are significantly below this Tier 2 screening level.

Degradation of Groundwater Assessment. Petroleum hydrocarbons have been detected in groundwater samples collected along and downgradient of FOPL segment G1/6/WTRF at concentrations that exceed the appropriate water quality objective for identifying sources of potential degradation to Mare Island Strait (chronic toxicity level for marine aquatic environments). Further, FOPL segment G1/6/WTRF is located approximately 85 feet away from Mare Island Strait, and petroleum hydrocarbons in groundwater at the site are not expected to degrade before migrating to the Strait. The results of previous investigations indicate that the primary and secondary sources of petroleum hydrocarbon contamination in groundwater (the FOPL and contaminated soil) have been removed.

Elevated concentrations of TPH-diesel and TPH-motor-oil have been detected in groundwater samples collected from 15W04B, 15W05, 15W10, 15W17, BE10GB009, and BE10GB010 since 1997. Based on data collected from this site since 1997, the EPCs for TPH-diesel and TPH-motor-oil are 550 µg/L and 850 µg/L, respectively. The EPC for TPH-diesel is below the chronic toxicity level for marine aquatic environments (640 µg/L). Therefore, TPH-diesel in groundwater at the site is not expected to result in a significant impact to Mare Island Strait.

The EPC for TPH-motor-oil exceeds the chronic toxicity level for marine aquatic environments. The greatest concentrations of TPH-motor-oil were detected in samples collected from 15W17 in 1998 and 1999. Groundwater samples have not been collected from this well since 1999. Additional data should be collected at this location to discern if elevated concentrations of TPH-motor-oil remain in groundwater. Groundwater samples will be collected from this well for four consecutive quarters and analyzed for TPH-motor-oil to determine if releases from FOPL segment G1/6/WTRF in the vicinity of 15W17 are resulting in an impact to the Strait. If the monitoring data indicate that elevated concentrations of TPH-motor-oil remain in groundwater, an evaluation will be performed following groundwater monitoring to determine the most technologically and economically feasible remedial alternative for the groundwater. If the data indicate that TPH-motor-oil is no longer present at elevated concentrations, then the conclusion will be made that previous releases from FOPL segment G1/6/WTRF are not impacting Mare Island Strait.

3.6.5 Conclusions

The entire length of FOPL segment G1/6/WTRF passed vacuum testing or was removed. Following vacuum testing, the pipeline was flushed and capped with concrete plugs, which eliminates the possibility of residual petroleum hydrocarbons being released to the adjacent subsurface. Therefore, any source of potential soil and groundwater contamination from this segment has been removed or remediated.

Sixty-eight soil samples were collected along this 1,211-foot span of FOPL between 1991 and 2003. Because the analytical data suggest that a release has occurred to soil and ground-water in the vicinity of this FOPL segment, a Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) to evaluate the potential risk from TPH-diesel and TPH-fuel-oil in soil and TPH-diesel, TPH-fuel-oil, and TPH-motor-oil in groundwater. These analytes were detected in samples collected along the FOPL segment at concentrations exceeding Tier 1 ESLs for industrial sites. The Tier 2 screening levels for these analytes in soil and groundwater are presented in Tables 1.4-3 and 1.4-4, respectively. COPCs were not detected in soil and groundwater at concentrations exceeding the corresponding Tier 2 screening levels. In addition, a baseline ERA concluded that constituents in groundwater at FOPL segment G1/6/WTRF do not pose a significant risk to aquatic organisms in the Strait. The methodology behind and results of the baseline ERA are provided in Attachment D1 of Appendix D.

Elevated concentrations of TPH-motor-oil detected at 15W17 in 1997, 1998, and 1999 suggest that previous releases from FOPL segment G1/6/WTRF may result in an impact to the Strait. Samples have not been collected from this well since 1999 to indicate if elevated concentrations of TPH-motor-oil remain in groundwater at this site. Consequently, groundwater monitoring will be performed at 15W17 to determine if TPH-motor-oil remains in groundwater at FOPL segment G1/6/WTRF and is impacting Mare Island Strait. Groundwater at monitoring well 15W17 will be sampled during four consecutive quarters. Groundwater samples collected from this well will also be analyzed for natural attenuation parameters to determine if petroleum hydrocarbons in groundwater (if detected) are degrading over time through natural attenuation. If quarterly groundwater monitoring indicates that the EPC for TPH-motor-oil is below the chronic toxicity level for marine aquatic environments, then it will be concluded that aquatic life and the Mare Island Strait are adequately protected and that the site is appropriate for closure. The results of this monitoring will be documented in a future report.

3.7 FOPL Segment G1/X/BE9

3.7.1 Site Description

FOPL segment G1/X/BE9 is 4 inches in diameter and connects with FOPL segment G1/6/WTRF at Berth 9 (Figure 2.4-1) (Weston 2001). It is 64 feet long and is located in IA C1 in an area with a proposed mixed (industrial) future land use (Figure 2.2-2). FOPL segment G1/X/BE9 is located on an area of Mare Island composed of fill material. Based on the depth of adjacent pipelines, this pipeline was likely present at approximately 3 feet bgs. The surface elevation at the location of FOPL segment G1/X/BE9 is approximately 10 feet bgs.

3.7.2 Previous Actions and Investigations

GPR was previously performed along this segment. GPR failed to locate this 64-foot section of pipeline, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). In addition, FOPL segment G1/X/BE9 was not encountered during removal of adjacent FOPL segment G1/6/WTRF, which was removed during 1997 (Weston 2001).

3.7.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment G1/X/BE9 were required following the previous investigation of the FOPL. A geophysical survey was performed during October 2002 in an attempt to locate FOPL segment G1/X/BE9 using GPR and metal-detection equipment. The results of the GPR survey are presented on Plate 42 in Appendix C. Although an unidentified utility was located during the survey, a trench could not be advanced at this location to confirm the presence of the FOPL due to the presence of active electrical lines in the subsurface. The electrical lines were observed when an attempt to advance the trench was made in July 2003.

Two borings (FOPLBE9GB0100 and FOPLBE9GB0101) were advanced along the suspected location of FOPL segment G1/X/BE9 during May 2002. Soil samples were collected at 5 feet bgs in both borings and also at 12 feet bgs at FOPLBE9GB0100. The direct-push rig could not advance through concrete that was encountered at 8.5 feet bgs at FOPLBE9GB0101. Therefore, a sample could not be collected from this boring at 12 feet bgs. No unusual visual or olfactory observations were made during drilling, and organic vapors were not detected with a PID.

3.7.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon contamination in soil in the vicinity of FOPL segment G1/X/BE9 were defined by sampling efforts performed during the 2002-2003 investigation of the FOPL. Three soil samples were collected along FOPL segment G1/X/BE9. The soil samples were not analyzed for BTEX compounds or PAHs. No groundwater samples have been collected along this FOPL segment.

3.7.4.1 Nature and Extent of Soil Contamination

TPH-diesel and TPH-motor-oil were not detected in the three soil samples collected along FOPL segment G1/X/BE9, as presented in Figure 3.2-1. These results suggest that former use of this pipeline did not result in releases to the subsurface.

3.7.5 Conclusions

FOPL segment G1/X/BE9 is appropriate for permanent closure. Although a trench could not be advanced at this 64-foot segment to confirm the presence of this pipeline, the pipeline was not encountered during removal of FOPL segment G1/6/WTRF, which formerly connected to one end of FOPL segment G1/X/BE9. Therefore, this FOPL segment was likely removed prior to removal of FOPL segment G1/6/WTRF in 1997.

The site has been adequately characterized. Analytical data collected along this segment indicate that a release has not occurred. This segment is not a threat to groundwater or surface water and presents no risk to human health or the environment. Therefore, the segment is a low-risk site and is appropriate for permanent closure.

3.8 FOPL Segment H1/4/BE3BE8

3.8.1 Site Description

FOPL segment H1/4/BE3BE8 is located in IA C1 along Berth 7 (Figure 2.4-1). The FOPL segment is located in an area with a proposed mixed (industrial) future land use (Figure 2.2-2). The FOPL segment consists of two parallel pipelines that are 4 inches in diameter and, in conjunction with FOPL segments G1/4/BE3BE8 and I1/4/BE3BE8, compose a “supply and return” fuel-oil distribution system that extends between Berth 3 and Berth 8. FOPL segment H1/4/BE3BE8 is 1,348 feet long and is buried from approximately 2 to 3.5 feet bgs.

Since this FOPL segment is located adjacent and parallel to Mare Island Strait, groundwater in the vicinity of this segment is tidally influenced. Groundwater flows to the northeast, towards Mare Island Strait (Figure 2.5-1). The surface elevation in the vicinity of FOPL segment H1/4/BE3BE8 is approximately 10 feet msl. The FOPL segment is located in fill material.

3.8.2 Previous Actions and Investigations

A field investigation was performed along FOPL segment H1/4/BE3BE8 during 1996 and 1997, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). One hundred fifty-two feet of FOPL segment H1/4/BE3BE8 were vacuum tested and flushed at two locations along the pipeline. The remaining 1,196 feet of FOPL segment H1/4/BE3BE8 were removed. Three soil samples (058 through 060) were collected following pipeline removal. Based on information presented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001), it is concluded that an unspecified quantity of contaminated soil was excavated at sample location 059. A confirmation sample (059A) was collected at this location following over-excavation.

3.8.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment H1/4/BE3BE8 were required following the previous investigation of the FOPL. Four borings (FOPLBE3BE8GB0100 and FOPLBE3BE8GB0103 through FOPLBE3BE8GB0105) were advanced during May and June 2003 to satisfy the criterion that samples be collected at a frequency of every 100 feet along removed segments in industrial areas and every 200 feet along flushed segments. One to two soil samples were collected from each boring at depths equal to and below the approximate former depth of the pipeline (3 to 8 feet bgs). Samples were collected from FOPLBE3BE8GB0101 to confirm the presence of contamination previously detected in sample 060. No unusual visual or olfactory observations were made during drilling, and organic vapors were not detected with a PID.

3.8.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAH contamination in soil and groundwater in the vicinity of FOPL segment H1/4/BE3BE8 were defined by sampling efforts performed during recent and previous investigations of the FOPL. Eight soil samples

were collected along this FOPL segment. No groundwater samples have been collected along this FOPL segment.

3.8.4.1 Nature and Extent of Soil Contamination

Elevated levels of petroleum hydrocarbons (up to 820 mg/kg) were detected in one soil sample (060) at 3.5 feet bgs following removal and flushing of the pipeline in 1996 and 1997. FOPLBE3BE8GB0101 was advanced at the same location as 060 in 2003 to confirm or refute previously detected TPH concentrations at that location. Soil samples collected at 3.5 feet bgs contained TPH-motor-oil at a concentration of 580 mg/kg. TPH-diesel was not quantified in this sample at a concentration exceeding analytical reporting limits. This is the same depth at which elevated concentrations were detected in 060 in 1997. This result suggests that contamination detected in sample 060 has biodegraded through natural attenuation over time. TPH-diesel and TPH-motor-oil were also not detected in a soil sample collected from FOPLBE3BE8GB0101 at 8 feet bgs.

The remaining soil samples collected during 2003 quantified only low levels (up to 67 mg/kg) of TPH-diesel and TPH-motor-oil. Analytical results for petroleum hydrocarbons in soil in the vicinity of FOPL segment H1/4/BE3BE8 are presented in Figure 3.8-1. These results indicate that elevated levels of petroleum hydrocarbons do not remain along FOPL segment H1/4/BE3BE8.

Three soil samples were submitted for analysis of BTEX compounds, and four soil samples were submitted for analysis of PAHs in the vicinity of this FOPL segment. BTEX compounds were not detected above laboratory reporting limits in any of the soil samples for which they were analyzed. PAHs were detected in soil samples 058 and 060. However, the analytical results for sample 060 are not representative of existing conditions, as data collected in 2003 indicate that hydrocarbon concentrations have decreased since the sample was collected in 1997. PAHs detected in sample 058 were detected at concentrations below Tier 1 ESLs (Figure 3.1-3).

3.8.5 Conclusions

FOPL segment H1/4/BE3BE8 is appropriate for permanent closure. The entire length of this FOPL segment passed vacuum testing or was removed. Following vacuum testing, the pipeline was flushed and capped with concrete plugs, which eliminates the possibility of residual petroleum hydrocarbons being released to the adjacent subsurface. Therefore, any source of potential soil and groundwater contamination from this segment has been removed or remediated.

This site has been adequately characterized. Eight soil samples were collected along this 1,348-foot span of FOPL between 1997 and 2003. While the analytical data suggest that a release has occurred to soil in the vicinity of FOPL segment H1/4/BE3BE8, the data collected during 2003 indicate that petroleum hydrocarbons previously detected at elevated concentrations along FOPL segment H1/4/BE3BE8 have biodegraded over time. Constituents are present along this FOPL segment at concentrations below Tier 1 ESLs. This site does not present a significant risk to human health or the environment. While a groundwater sample has not been collected in the vicinity of FOPL segment H1/4/BE3BE8, heavy, long-chain fraction hydrocarbons are relatively insoluble and are not expected to be mobilized to groundwater based on the low concentrations of petroleum hydrocarbons detected in soil.

Therefore, previous releases from FOPL segment H1/4/BE3BE8 most likely did not result in an impact to groundwater or surface water. FOPL segment H1/4/BE3BE8 is a low-risk fuel site and is appropriate for permanent closure.

3.9 FOPL Segments G1/4/3ST

3.9.1 Site Description

FOPL segment G1/4/3ST is located in portions of IA B and IA C1 with proposed mixed (industrial) future land uses (Figure 2.2-2). The FOPL segment runs west of Building 77 and south of Buildings 227, 227A, 111, and 207 between Railroad Avenue and Nimitz Avenue (formerly California Avenue) (Figure 2.4-1). The FOPL segment is approximately 644 feet long and has a 4-inch diameter. It connects with FOPL segment G2/4/3ST at its western end and with FOPL segments G1/2/B207 and G1/X/B207B at its eastern end. The FOPL segment is located at approximately 7 feet bgs.

This FOPL segment is located in an area with a surface elevation of 17 to 18 feet above msl. FOPL segment G1/4/3ST is located within the original Mare Island boundary. The groundwater flow direction at the site is to the northeast towards Mare Island Strait (Figure 2.5-1). FOPL segment G1/4/3ST is located approximately 500 feet from Mare Island Strait.

3.9.2 Previous Actions and Investigations

A field investigation was performed along FOPL segment G1/4/3ST during 1998 and 1999, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). During the investigation, 430 feet of this segment were removed. In addition, a 214-foot section of the segment running beneath Railroad and Nimitz Avenues was flushed. The flushed portions of the FOPL segment passed vacuum testing and were capped following pipeline flushing. Three soil samples (083, 084, and 111) were collected following pipeline removal activities at 6.5 to 7 feet bgs.

Sixteen additional soil samples were collected from 4 to 10.5 feet bgs from seven borings (B257GB011, B207GB001, B207GB002, B207GB014, B207GB015, B207GB016, B207GB017) advanced during investigations performed in 1999 and 2000 to characterize contamination associated with the FOPL (TtEMI and Washington 2001). The purpose of this investigation was to locate underground fuel lines and associated leaks, characterize the horizontal and vertical extent of soil and groundwater contamination, and identify and locate any additional sources of contamination. Soil samples were analyzed for TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX compounds.

3.9.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment G1/4/3ST were required following the previous investigations of the FOPL. Ten borings (FOPL3STGB0107A through FOPL3STGB0107G, FOPL3STGB0108A, and FOPL3STGB0109A through FOPL3STGB0109C) were advanced during July, August, and October 2003 at locations presented in Figure 3.8-1. The purpose of these borings was to define the lateral and vertical extents of contamination detected during previous investigations through

collection of soil samples. Twenty soil and six groundwater samples were collected from these borings. Samples were analyzed for TPH-diesel, TPH-motor-oil, and, in some cases, PAHs. In addition, a sample collected from 7 feet bgs at FOPL3STGB0109C was analyzed for PCBs. Petroleum hydrocarbon odors and/or staining were detected during drilling at FOPL3STGB0107A, FOPL3STGB0107B, FOPL3STGB0107C, and FOPL3STGB0109A at the depth intervals presented in Table 3.9-1.

TABLE 3.9-1

Significant Observations Made During Drilling at FOPL Segment G1/4/3ST in 2003
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

Location	Depth of Odor	Depth of Staining	Maximum PID reading and depth
FOPL3STGB0107A	2 to 12 feet bgs	9 to 12 feet bgs	93 ppm at 6 feet bgs
FOPL3STGB0107B	8 to 12 feet bgs	8 to 12 feet bgs	354 ppm at 9 feet bgs
FOPL3STGB0107C	NA	12 to 14 feet bgs	242 ppm at 4 feet bgs
FOPL3STGB0109A	5 to 10 feet bgs	NA	110 ppm at 7 feet bgs

Notes:

NA = not applicable
ppm = parts per million

3.9.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAH contamination in soil and groundwater in the vicinity of FOPL segment G1/4/3ST were defined by sampling efforts performed during previous and recent investigations of the FOPL. Thirty-six soil and seven grab groundwater samples have been collected along this 644-foot segment.

3.9.4.1 Nature and Extent of Soil Contamination

Elevated concentrations of petroleum hydrocarbons have been detected at the eastern end of this FOPL segment. TPH-diesel, TPH-fuel-oil, and TPH-motor-oil were detected at maximum concentrations of 5,500 mg/kg, 7,800 mg/kg, and 4,200 mg/kg, respectively, in soil samples collected from the eastern end of the segment during previous investigations. Subsequent sampling performed in 2003 to define the extent of this contamination detected elevated concentrations of petroleum hydrocarbons up to 120 feet southeast of the eastern end of FOPL segment G1/4/3ST. The maximum concentrations of TPH-diesel and TPH-motor-oil (11,000 mg/kg and 8,200 mg/kg, respectively) were detected at FOPL3STGB0107A at 4 feet bgs (Figure 3.8-1). This location is approximately 70 feet southeast of the eastern end of the FOPL segment. TPH-diesel and TPH-motor-oil were also detected at concentrations exceeding Tier 1 ESLs for industrial sites in samples collected at FOPL3STGB0107B, FOPL3STGB0107C, FOPL3STGB0107E, FOPL3STGB0107F, FOPL3STGB0109A, B207GB016, B207GB002, and 111 4.5 to 9.5 feet bgs. The vertical and lateral extents of contamination detected south of the eastern end of FOPL segment G1/4/3ST are defined by data collected in 2000 and 2003.

Six soil samples collected at FOPL segment G1/4/3ST were analyzed for PAHs. These soil samples were collected at depths of 4 to 9.5 feet bgs at FOPL3STGB0107A through

FOPL3STGB0107C, FOPL3STGB0107E, FOPL3STGB0109A, and FOPL3STGB0109C (in the same samples that contained elevated concentrations of petroleum hydrocarbons). The results of analyses for PAHs are presented in Figure 3.1-3. PAHs were not detected at concentrations exceeding the Tier 1 ESLs for industrial sites.

Twenty soil samples were analyzed for BTEX compounds. The results of analyses for BTEX compounds are presented in Figure 3.1-2. While BTEX compounds were detected at concentrations exceeding analytical reporting limits in five samples (collected from 111, B207GB002, and B207GB016), BTEX compounds were not detected at concentrations exceeding Tier 1 ESLs in any of the soil samples collected along FOPL segment G1/4/3ST. The sample submitted for analysis of PCBs (FOPL3STGB0109C at 7 feet bgs) did not contain PCBs at concentrations exceeding analytical reporting limits.

A Tier 2 risk analysis was performed based on the site-specific conditions of FOPL segment G1/4/3ST to derive Tier 2 screening levels for analytes that were detected at concentrations exceeding Tier 1 ESLs along this FOPL segment. The methodology used to derive Tier 2 screening levels is presented in Appendix D. The Tier 2 screening level for TPH-diesel, TPH-fuel-oil, and TPH-motor-oil in soil is 10,000 mg/kg, as presented in Table 1.4-3. The EPC for each COPC is less than the corresponding Tier 2 screening level, suggesting that soil contamination at this site does not present a significant risk to human health or the environment.

3.9.4.2 Nature and Extent of Groundwater Contamination

Seven groundwater samples have been submitted for analysis of petroleum hydrocarbons. TPH-diesel and/or TPH-motor-oil were detected at concentrations exceeding Tier 1 ESLs in three of the samples. The maximum concentrations of these analytes (2,600 µg/L and 1,200 µg/L, respectively) were detected in a grab groundwater sample collected from FOPL3STGB0109A, which is approximately 13 feet southeast of FOPL segment G1/4/3ST. A sample collected from FOPL3STGB0109B approximately 15 feet downgradient of this sample did not contain TPH-diesel or TPH-motor-oil at concentrations exceeding analytical reporting limits. Elevated concentrations were also detected further south from the FOPL segment at FOPL3STGB0107B and FOPL3STGB0107D (as presented in Figure 3.8-1). The analytical result for TPH-motor-oil in groundwater at FOPL3STGB0107D is only slightly above the Tier 1 ESL (640 µg/L), indicating that the extent of petroleum hydrocarbons detected at elevated concentrations upgradient of this sample at FOPL3STGB0107B are laterally delineated. TPH-diesel was not detected in the sample collected at FOPL3STGB0107D. Petroleum hydrocarbons were not detected above analytical reporting limits in the grab groundwater sample collected downgradient of the FOPL segment (B207GB013).

Six groundwater samples were analyzed for PAHs. PAHs were not detected at concentrations exceeding Tier 1 ESLs in any of the samples (Figure 3.1-3). The sample collected downgradient of FOPL segment G1/4/3ST (B207GB013) was analyzed for BTEX compounds. BTEX compounds were not detected at concentrations exceeding analytical reporting limits in this sample.

A Tier 2 risk analysis was performed based on the site-specific conditions of FOPL segment G1/4/3ST to derive Tier 2 screening levels for analytes that were detected at concentrations

exceeding Tier 1 ESLs in groundwater at this FOPL segment. The Tier 2 screening level for TPH-diesel and TPH-motor-oil in groundwater is 50,000 µg/L, as presented in Table 1.4-4. All constituents in samples collected along or downgradient of this FOPL segment were detected at concentrations less than the corresponding Tier 2 screening level, suggesting that groundwater contamination at this site does not present a significant risk to human health or the environment.

3.9.5 Conclusions

FOPL segment G1/4/3ST is appropriate for permanent closure. The entire length of this FOPL segment passed vacuum testing or was removed. Following vacuum testing, the pipeline was rinsed and capped with concrete plugs, which eliminates the possibility of residual petroleum hydrocarbons being released to the adjacent subsurface. Therefore, the source of potential soil and groundwater contamination was removed or remediated.

The site has been adequately characterized. Thirty-six soil and seven groundwater samples have been collected along, south, or downgradient of this 644-foot segment. While the analytical data suggest that a release has occurred to soil in the vicinity of FOPL segment G1/4/3ST, the results of a Tier 2 risk analysis indicate that elevated concentrations of TPH-diesel, TPH-fuel-oil, and TPH-motor-oil in soil and TPH-diesel and TPH-motor-oil in groundwater do not pose a risk at the site and do not pose a threat to surface water or groundwater. The Tier 2 screening levels for these analytes in soil and groundwater are presented in Tables 1.4-3 and 1.4-4, respectively. All COPCs were detected at concentrations less than the corresponding Tier 2 screening levels. In addition, the nearest surface water body (Mare Island Strait) is approximately 500 feet away, which is too far away from FOPL segment G1/4/3ST to be impacted by immiscible long-chained hydrocarbons. Therefore, FOPL segment G1/4/3ST is a low-risk fuel site and is appropriate for permanent closure.

3.10 FOPL Segment G1/X/B207S

3.10.1 Site Description

FOPL segment G1/X/B207S is located in an area of IA C1 with proposed mixed (industrial) land use (Figure 2.2-2). FOPL segment G1/X/B207S has a 2-inch diameter and extends from within Building 111 to the intersection with FOPL segment H1/X/B207S (east of Building 207 in Nimitz Avenue), as presented in Figure 2.4-1. The pipeline is approximately 240 feet long. The pipeline is presumed to be located at approximately 3 feet bgs. FOPL segment G1/X/B207S is located in an area of Mare Island composed of fill material. This FOPL segment is located in an area with a surface elevation of 17 to 18 feet above msl. The site is located approximately 530 feet from Mare Island Strait.

3.10.2 Previous Actions and Investigations

FOPL segment G1/X/B207S has been included in two previous actions between 1997 and 2001. During 1997 and 1998, 215 feet of pipeline were removed, and 25 feet of pipeline beneath Building 111 were never located, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). No soil samples were collected along the removed portion of this segment during this investigation.

From 1999 to 2001, 48 soil and four grab groundwater samples were collected from 24 borings located in vicinity of Building 207, as documented in the *Fuel Pipeline Investigation Status Report for Buildings 85, 207, 257, 386, 388, and 390* (TtEMI and Washington 2001). The purpose of this investigation was to locate underground fuel lines and associated leaks, characterize the horizontal and vertical extent of soil and groundwater contamination, and identify and locate any additional sources of contamination. One of the 24 borings (B207GB003) was located in the vicinity of FOPL segment G1/X/B207S. Two soil samples were collected from this boring at 4.5 and 9 feet bgs. This investigation concluded that further investigation and sampling was necessary to assess the extent of TPH contamination in soil and groundwater at the Building 207 Area.

3.10.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment G1/X/B207S were required following the previous investigations. During June 2003, one boring (FOPLB207SGB0100) was advanced to confirm that potential releases from this FOPL segment did not result in significant concentrations of petroleum hydrocarbons in the surrounding soil. One soil sample was collected from boring FOPLB207SGB0100 at 3 feet bgs and submitted for analysis of TPH-diesel, TPH-motor-oil, and PAHs. No unusual visual or olfactory observations were made during operations, and organic vapors were not detected with a PID.

3.10.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbons, BTEX compounds, and PAHs in soil in the vicinity of FOPL segment G1/X/B207S were defined by sampling efforts performed during previous and recent investigations of the FOPL. Three soil samples have been collected along this 240-foot segment. No groundwater samples have been collected in the vicinity of this segment.

3.10.4.1 Nature and Extent of Soil Contamination

The maximum concentration of petroleum hydrocarbons were detected in samples collected in 1999 from B207GB003, which is located near a 90-degree bend of FOPL segment G1/X/B207S at Nimitz Avenue. TPH-fuel-oil was detected in samples collected from this boring at concentrations of 6,000 mg/kg (4.5 feet bgs) and 1,300 mg/kg (9 feet bgs). These data suggest that a release formerly occurred at a 90-degree bend in the pipeline. Low concentrations of ethylbenzene and xylenes were detected in samples collected from B207GB003, as presented in Figure 3.1-2. Only low concentrations of petroleum hydrocarbons were detected in the soil sample collected from 3 feet bgs at FOPLB207SGB0100 in 2003 (Figure 3.8-1). PAHs were not detected above analytical reporting limits in this samples.

A Tier 2 risk analysis was performed for FOPL segment G1/X/B207S based on site-specific information and in accordance with RWQCB guidance (RWQCB 2003). The methodology for deriving the Tier 2 screening levels is presented in Appendix D. The site-specific Tier 2 screening level for TPH-fuel-oil in soil at FOPL segment G1/X/B207S has been determined

to be 10,000 mg/kg (Table 1.4-3). Residual concentrations of TPH remaining in soil at FOPL segment G1/X/B207S are significantly below this Tier 2 screening level.

3.10.4.2 Nature and Extent of Groundwater Contamination

While groundwater samples have not been collected in the immediate vicinity of this FOPL segment, a groundwater sample collected downgradient of FOPL segment G1/X/B207S (FOPLB207GB0100A) in 2003 indicates that significant concentrations of petroleum hydrocarbons are not present in groundwater in the area. This suggests that previous releases of petroleum hydrocarbons from FOPL segment G1/X/B207S to soil have not resulted in a significant impact to groundwater. TPH-motor-oil was detected at a concentration slightly above the Tier 1 ESL (680 µg/L) and will be addressed in the Tier 2 risk analysis for FOPL segment G1/2/B207 (Section 4.6).

3.10.5 Conclusions,

FOPL segment G1/X/B207S is appropriate for permanent closure. Except for a 25-foot span of pipeline that has not been located, the entire length of this FOPL segment was removed during previous investigations. The previously non-located portion of pipeline is suspected to no longer be present, as it was not observed during the removal of the remainder of the FOPL segment. Therefore, any source of potential soil and groundwater contamination from these segments has been removed or remediated.

This site has been adequately characterized. Three soil samples were collected along this 240-foot span of FOPL between 1999 and 2003. In 1999, elevated concentrations of petroleum hydrocarbons were detected near a 90-degree bend of FOPL segment G1/X/B207S, suggesting that a release formerly occurred at this location. A Tier 2 risk analysis was performed to derive site-specific Tier 2 screening levels. Residual concentrations of TPH-fuel-oil remaining in soil are significantly below the Tier 2 screening level of 10,000 mg/kg. The nearest surface water body (Mare Island Strait) is approximately 530 feet away, which is too far away from FOPL segment G1/4/3ST to be impacted by immiscible long-chained hydrocarbons. Based on the analytical data and observations from subsurface investigations, this segment is not a threat to groundwater or surface water and presents no risk to human health or the environment. The segment is therefore a low-risk site and is appropriate for permanent closure.

3.11 FOPL Segment G1/X/B207B

3.11.1 Site Description

FOPL segment G1/X/B207B is located in IA C1 in an area with a proposed mixed (industrial) land use (Figure 2.2-2). This FOPL segment is approximately 25 feet long and extends northeast from the intersection of FOPL segments G1/2/B207 and G1/4/3ST. This FOPL segment is located east of Nimitz Avenue near the intersection with Connolly Street and is located underneath a parking lot south of Building 85 (Figure 2.4-1). The depth of this pipeline is unknown but is likely located approximately 6.5 feet bgs, based on the depth of adjacent FOPL segments. The diameter of this FOPL segment is unknown.

3.11.2 Previous Actions and Investigations

No attempt to locate this FOPL segment has been made during previous investigations. However, two borings were advanced along and immediately downgradient of this FOPL segment during an investigation of the FOPL performed in 2000. The purpose of this investigation was to locate underground fuel lines and associated leaks, characterize the horizontal and vertical extent of soil and groundwater contamination, and identify and locate any additional sources of contamination (TtEMI and Washington 2001). Figure 3.8-1 presents the locations of these borings (B207GB012 and B207GB013). Two soil samples were collected from each boring at approximately 5 and 10 feet bgs and analyzed for petroleum hydrocarbons and BTEX compounds. Additionally, one groundwater sample was collected from B207GB013 and was analyzed for petroleum hydrocarbons and BTEX compounds.

3.11.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment G1/X/B207B were required following the previous investigation. A geophysical survey was performed along FOPL segment G1/X/B207B during October 2002 in an attempt to locate the FOPL segment using GPR and metal-detection equipment. The results of the GPR survey are presented on Plate 23 in Appendix C. The pipeline was not located during the geophysical survey, suggesting that the pipeline is no longer present in the subsurface. To confirm these results, an exploratory trench was advanced during July 2003. The trench was advanced a distance of approximately 26 feet in the direction perpendicular to the suspected orientation of the FOPL at the location presented in Figure 3.8-1. The trench was advanced to a depth of 12 feet bgs. No pipelines suspected of being the FOPL were identified during trenching activities. In addition, no indication of petroleum hydrocarbon contamination in soil was observed during trenching.

To confirm that this former FOPL segment historically did not release petroleum hydrocarbons to the subsurface, soil samples were collected from a boring (FOPLB207BGB0100) advanced in May 2003. A sample was collected from 6.5 feet bgs and analyzed for TPH-diesel and TPH-motor-oil. Additionally, a boring (FOPLB207GB0100A) was advanced adjacent to the former location of FOPL segment G1/X/B207B during characterization of FOPL segment G1/2/B207 in June 2003. Soil samples were collected from this boring at 6 and 9 feet bgs and analyzed for TPH-diesel and TPH-motor-oil. A groundwater sample was also collected from this boring and analyzed for TPH-diesel, TPH-motor-oil, and PAHs. No unusual visual or olfactory observations were made during drilling of borings FOPLB207BGB0100 and FOPLB207GB0100A, and organic vapors were not detected with a PID.

3.11.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon and BTEX contamination in soil and petroleum hydrocarbon and PAH contamination in groundwater in the vicinity of FOPL segment G1/X/B207B were defined by sampling efforts performed during recent and previous investigations of the FOPL. Seven soil samples and two groundwater samples were collected along this FOPL segment.

3.11.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons generally were not detected in the soil samples collected adjacent to FOPL segment G1/X/B207B, as presented in Figure 3.8-1. Very low concentrations (10 mg/kg and 13 mg/kg) of TPH-diesel were detected in soil samples collected from B207GB013. BTEX compounds were not detected in the soil samples collected adjacent to FOPL segment G1/X/B207B (Figure 3.1-2).

3.11.4.2 Nature and Extent of Groundwater Contamination

TPH-diesel and TPH-motor-oil were detected at concentrations of 600 µg/L and 680 µg/L, respectively, in the grab groundwater sample collected from FOPLB207GB0100A. This contamination is associated with historical releases from FOPL segment G1/2/B207 and will be evaluated with that segment (Section 4.6). PAHs were not detected in this groundwater sample. TPH-diesel, TPH-fuel-oil, and BTEX compounds were not detected in the grab groundwater sample collected from B207GB013, which is located downgradient of FOPL segment G1/X/B207B. TPH-motor-oil was collected in this sample at a concentration of 100 µg/L, which is below the Tier 1 ESL for this analyte (640 µg/L).

3.11.5 Conclusions

FOPL segment G1/X/B207B is appropriate for permanent closure. The results of exploratory trenching and a geophysical survey along the FOPL segment indicate that this segment is no longer present. Therefore, any source of potential soil and groundwater contamination from these segments has been removed. Additionally, the site has been adequately characterized. Analytical data from soil samples collected in the vicinity of the segment indicate that a release has not occurred from FOPL segment G1/X/B207B and that an impact to groundwater likely has not occurred at this site. Based on the analytical data, the segment is not a threat to groundwater or surface water and presents no significant risk to human health or the environment. The segment is therefore a low-risk fuel site and is appropriate for permanent closure.

3.12 FOPL Segment H1/X/B207S

3.12.1 Site Description

FOPL segment H1/X/B207S is located in areas of IA C1 with proposed mixed (industrial) land use (Figure 2.2-2). FOPL segment H1/X/B207S has a 2-inch diameter and extends along the east side of Building 207 in Nimitz Avenue between FOPL segments G1/X/B207S and H1/2/B111, as presented in Figure 2.4-1. This FOPL segment is approximately 201 feet long and is presumed to have been buried at approximately 2.5 to 3 feet bgs. The site is located approximately 530 feet from Mare Island Strait in an area of Mare Island composed of fill material. The groundwater flow direction in the vicinity of the FOPL segment is to the northeast (Figure 2.5-1). This FOPL segment is located in an area with a surface elevation of 17 feet above msl.

3.12.2 Previous Actions and Investigations

FOPL segment H1/X/B207S has been included in two previous actions performed between 1999 and 2001. During 1999, all 201 feet of pipeline were removed, as documented in the

Draft Removal Summary Report for Fuel Oil Pipelines (Weston 2001). Four soil samples (112, 113, 115, and 116) were initially collected along this FOPL segment from 2.5 to 8 feet bgs. Due to the presence of petroleum hydrocarbon contamination at one sample location (113), an unspecified volume of soil was over-excavated, and a confirmatory soil sample (113A) was collected.

From 1999 to 2001, 48 soil and four grab groundwater samples were collected from 24 borings located in vicinity of Building 207, as documented in the *Fuel Pipeline Investigation Status Report for Buildings 85, 207, 257, 386, 388, and 390* (TtEMI and Washington 2001). The purpose of this investigation was to locate underground fuel lines and associated leaks, characterize the horizontal and vertical extent of soil and groundwater contamination, and identify and locate any additional sources of contamination. Two of the 24 borings (B207GB005 and B207GB023) were located in the vicinity of FOPL segment H1/X/B207S. Two soil samples were collected from each boring at 4.5 to 10 feet bgs. Soil samples were analyzed for TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX compounds. This investigation concluded that further investigation and sampling were necessary to assess the extent of TPH contamination in soil and groundwater at the Building 207 Area.

3.12.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment H1/X/B207S were required following the previous investigations. During July and August 2003, six borings (FOPLB207SGB0101A, FOPLB207SGB0101B, FOPLB207SGB0102A, FOPLB207SGB0102B, FOPLB207SGB0102C, and FOPLB207AGB0101B) were advanced to confirm that potential releases from this FOPL segment did not result in significant concentrations of petroleum hydrocarbons in the soil and groundwater downgradient of the FOPL segment. Thirteen soil samples were collected from the six boring locations at depths between 7 and 17 feet bgs and submitted for analysis of TPH-diesel, TPH-motor-oil and, in some cases, PAHs. Additionally, a grab groundwater sample was collected from each of the six borings and submitted for analysis of TPH-diesel, TPH-motor-oil, and PAHs.

During drilling operations at FOPL segment H1/X/B207S, visual and olfactory observations were documented indicating the presence of low levels of petroleum hydrocarbons in the subsurface. Hydrocarbon-type odor was observed at FOPLB207SGB0101A from 7 to 12.5 feet bgs, and organic vapors were detected in the headspace in a sample collected from 10 feet bgs at 195 parts per million (ppm). Slight hydrocarbon-type soil staining and odor were observed at FOPLB207SGB0102B from 8 to 12 feet bgs. In addition, hydrocarbon staining and odor was noted from 5 to 11 feet bgs at FOPLB207AGB0101B. Organic vapors were detected at concentrations up to 248 ppm (at 8 feet bgs). These observations are documented in the lithologic logs for these borings presented in Appendix B to this report.

3.12.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAH contamination in soil and groundwater in the vicinity of FOPL segment H1/X/B207S were defined by sampling efforts performed during recent and previous investigations of the FOPL. Twenty-one soil samples and six groundwater samples were collected along this FOPL segment.

3.12.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons were detected in soil at elevated concentrations in the vicinity of FOPL segment H1/X/B207S, as shown in Figure 3.8-1. Thirteen soil samples contained petroleum hydrocarbon compounds at concentrations exceeding Tier 1 ESLs for industrial sites. TPH-fuel-oil was detected at a maximum concentration of 11,000 mg/kg in both sample 113A (at 9 feet bgs in April 1999) and sample 112 (at 7 feet bgs in March 1999). An elevated concentration of TPH-fuel-oil (8,700 mg/kg) was also detected in sample 115. Soil samples were collected downgradient of these samples during 2000 and 2003 to define the lateral extent of contamination in the downgradient direction. Soil samples collected from FOPLB207SGB0102A, which is located within 15 feet downgradient of 113A and 115, contained TPH-diesel and TPH-motor-oil at maximum concentrations of 880 mg/kg and 540 mg/kg, respectively, in a sample collected from 9 feet bgs. The result for TPH-diesel slightly exceeds the Tier 1 ESL for TPH-diesel (500 mg/kg). Consequently, FOPLB207SGB0102B was advanced approximately 15 feet downgradient of FOPLB207SGB0102A. TPH-diesel was also detected at concentrations exceeding the Tier 1 ESL in samples collected from this boring at 9 and 12 feet bgs (at 730 mg/kg and 560 mg/kg, respectively). FOPLB207SGB0102C was advanced approximately 33 feet downgradient of FOPLB207SGB0102B to define the lateral extent of TPH-diesel in this area. Neither TPH-diesel nor TPH-motor-oil were detected at concentrations exceeding analytical reporting limits in a sample collected from 10 feet bgs in this boring.

Soil boring B207GB005 is co-located with the location of sample 112. TPH-fuel-oil was detected in this boring at a maximum concentration of 6,000 mg/kg (at 8 feet bgs). Soil samples collected from FOPLB207SGB0101A, which is located approximately 17 feet downgradient of sample locations 112 and B207GB005, contained TPH-diesel and TPH-motor-oil at maximum concentrations of 4,200 mg/kg and 3,300 mg/kg, respectively (in a sample collected from 10 feet bgs). The vertical extent of contamination at this location is defined by a sample collected at 12 feet bgs with low concentrations of petroleum hydrocarbons. Soil samples collected approximately 13 feet downgradient of this boring at 5, 7, 9.5, and 10 (at FOPLB207SGB0101B and B207GB019) contained only low concentrations of petroleum hydrocarbons. These results suggest that the lateral extent of contamination of the areas with the greatest concentrations of petroleum hydrocarbons along FOPL segment H1/X/B207S is defined in the downgradient direction.

FOPLB207AGB0101B was advanced immediately downgradient of FOPL segment H1/2/B207S during an investigation of FOPL segment H1/2/B207A. TPH-diesel and TPH-motor-oil were detected in samples collected from this boring at maximum concentrations of 3,100 mg/kg and 2,700 mg/kg, respectively (Figure 3.8-1). However, petroleum hydrocarbons were not detected at elevated concentrations in FOPLB207AGB0101C, which is located approximately 30 feet downgradient of FOPLB207AGB0101B.

Select PAHs were detected in the three soil samples for which they were analyzed (Figure 3.1-3). However, PAHs were not detected at concentrations above Tier 1 ESLs. Seven soil samples were analyzed for BTEX compounds. BTEX compounds were detected in four samples collected along FOPL segment H1/X/B207S. Ethylbenzene, toluene, and xylene were detected at maximum concentrations of 0.026 mg/kg, 0.42 mg/kg, and 0.5 mg/kg, respectively (Figure 3.1-2). These results are below the Tier 1 ESLs for industrial sites.

Samples collected during previous investigations between 1999 and 2003 contained TPH-diesel, TPH-fuel-oil, and TPH-motor-oil at concentrations above Tier 1 ESLs. Consequently, Tier 2 risk analysis was performed for FOPL segment H1/X/B207S, as presented in Appendix D. The site-specific Tier 2 screening level for TPH-diesel, TPH-fuel-oil, and TPH-motor-oil in surface and subsurface soil at FOPL segment H1/X/B207S is 10,000 mg/kg (Table 1.4-3). As indicated by a statistical analysis presented in Appendix D, the EPC (95 percent upper confidence limit or UCL [bootstrap-t]) for TPH-diesel and TPH-fuel-oil in surface soil is approximately 5,700 mg/kg and the EPC for TPH-motor-oil in surface soil is 3,300 mg/kg. Residual concentrations of TPH remaining in soil at FOPL segment H1/X/B207S are significantly below the Tier 2 screening level.

3.12.4.2 Nature and Extent of Groundwater Contamination

Six groundwater samples were collected in 2000 and 2003, all of which were within 20 feet downgradient of segment H1/X/B207S. Each sample contained TPH-diesel and TPH-motor-oil at concentrations exceeding Tier 1 ESLs. The greatest concentrations of TPH-diesel and TPH-motor-oil were detected in samples collected from FOPLB207SGB0101A and FOPLB207AGB0101B (up to 7,800 µg/L and 5,700 µg/L, respectively). However, grab groundwater samples collected downgradient of these samples indicate significantly lower petroleum hydrocarbons concentrations. Petroleum hydrocarbons were not detected above analytical reporting limits at a location approximately 30 feet downgradient of FOPLB207SGB0101A and were only detected up to 1,200 µg/L in a sample collected approximately 30 feet downgradient of FOPLB207AGB0101B. Similarly, elevated concentrations of TPH-diesel and TPH-motor-oil detected at FOPLB207SGB0102A are defined in the downgradient direction. TPH-diesel was not detected, and TPH-motor-oil was detected at a concentration only slightly exceeding the Tier 1 ESL (850 µg/L) in a sample collected approximately 50 feet downgradient of FOPLB207SGB0102A. Elevated concentrations of petroleum hydrocarbons in groundwater do not appear to extend more than 100 feet downgradient of FOPL segment H1/X/B207S (Figure 3.8-1).

Six groundwater samples were analyzed for PAHs. Four PAHs (acenaphthene, chrysene, fluorene, and pyrene) were detected in the groundwater samples collected in the vicinity of FOPL segment H1/X/B207S (Figure 3.1-3). PAHs were not detected at concentrations exceeding Tier 1 ESLs.

A Tier 2 risk analysis was performed for groundwater at FOPL segment H1/X/B207S, as presented in Appendix D. Tier 2 screening levels were derived in accordance with RWQCB guidance (RWQCB 2003) and based on site-specific conditions. The site-specific Tier 2 screening level for TPH-diesel and TPH-motor-oil in groundwater at FOPL segment H1/X/B207S is 50,000 µg/L (Table 1.4-4). Residual concentrations of petroleum hydrocarbons remaining in groundwater at FOPL segment H1/X/B207S are significantly below this Tier 2 screening level.

3.12.5 Conclusions

FOPL segment H1/X/B207S is appropriate for permanent closure. The entire length of FOPL segment H1/X/B207S was removed. Therefore, any source of potential soil and groundwater contamination from these segments has been removed.

This site has been adequately characterized. Twenty-one soil samples and six groundwater samples were collected from 12 locations along this 201-foot span of FOPL between 1999 and 2003. While analytical data indicate that a release historically occurred to soil and groundwater in the vicinity of FOPL segment H1/X/B207S, the results of a Tier 2 risk analysis indicate that constituents in soil and groundwater do not pose an unacceptable risk to human health or the environment. A Tier 2 risk analysis was performed for the segment due to elevated TPH-diesel, TPH-motor-oil, and TPH-fuel-oil concentrations observed in soil and TPH-diesel and TPH-motor-oil concentrations observed in groundwater samples collected in 1999 and in 2003. As presented in Appendix D and Tables 1.4-3 and 1.4-4, the EPCs for these analytes are below the corresponding Tier 2 screening levels.

Elevated concentrations of petroleum hydrocarbons in groundwater do not appear to extend more than 100 feet downgradient of FOPL segment H1/X/B207S. The FOPL segment is located approximately 530 feet from Mare Island Strait. Therefore, Mare Island Strait is not expected to be impacted by long-chained immiscible hydrocarbons in soil and groundwater at the site. Based on the analytical data and observations from subsurface investigations, this segment is not a threat to groundwater or surface water and presents no risk to human health or the environment. The segment is therefore a low-risk site and is appropriate for permanent closure.

3.13 FOPL Segment H1/2/B111

3.13.1 Site Description

FOPL segment H1/2/B111 is located in an area of IA C1 with proposed mixed (industrial) land use (Figure 2.2-2). FOPL segment H1/2/B111 has a 2-inch diameter and extends from the north end of Building 111 to an intersection with FOPL segments H1/6/B85 and H1/2/B85S south of Building 85, as presented in Figure 2.4-1. This pipeline is approximately 497 feet long and is located at approximately 1 foot bgs. FOPL segment H1/2/B111 is located within the original Mare Island boundary. This FOPL segment is located in an area with a surface elevation of 17 feet above msl. The site is located over 500 feet away from Mare Island Strait, which is the closest surface water body.

3.13.2 Previous Actions and Investigations

FOPL segment H1/2/B111 has been included in two previous actions between 1997 and 2001. During 1998 and 1999, 318 feet of pipeline located west of Building 87 were removed, and the remaining 179 feet were flushed, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). Prior to flushing, the segment passed a vacuum test. Nine soil samples were collected along the removed portion of this segment following removal actions. These locations (075, 076, 077, 082, 082A, 082B, 082C, 082D, and 114) are presented in Figure 3.8-1. Pipe corrosion and soil contamination were encountered near the northwest corner of Building 207 along FOPL segment H1/2/B111. The excavation in this area was extended to remove an unspecified quantity of contaminated soil (at the location of sample 082).

From 1999 to 2001, 48 soil and four grab groundwater samples were collected from 24 borings located in vicinity of Building 207, as documented in the *Fuel Pipeline Investigation Status Report for Buildings 85, 207, 257, 386, 388, and 390* (TtEMI and Washington 2001). The

purpose of this investigation was to locate underground fuel lines and associated leaks, characterize the horizontal and vertical extent of soil and groundwater contamination, and identify and locate any additional sources of contamination. Eight of the 24 borings (B085GB001, B085GB002, B085GB003, B085GB004, B207GB006, B207GB007, B207GB021, B207GB024) were located in the vicinity of FOPL segment H1/2/B111. Soil samples were collected from these borings from 4 to 10 feet bgs. Further investigation and sampling were recommended to assess the extent of TPH contamination in soil and groundwater at the Building 207 Area.

3.13.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final FOPL SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment H1/2/B111 were required following the previous investigations. During June 2003, two borings (FOPLB111GB0100 and FOPLB111GB0101) were advanced to confirm that potential releases from this FOPL segment did not result in significant concentrations of petroleum hydrocarbons in the surrounding soil and groundwater. Eight additional borings (FOPLB111GB0100A, FOPLB111GB0101A, FOPLB111GB0101B, FOPLB111GB0101C, FOPLB111GB0101D, FOPLB111GB0101E, FOPLB111GB0101F, and FOPLB111GB0101G) were advanced between July and October 2003 to delineate elevated concentrations of TPH and PAHs detected from soil samples collected at FOPLB111GB0100 and FOPLB111GB0101 (Section 3.13.4). These sample locations are presented in Figure 3.8-1. Twenty soil samples were collected from the 10 boring locations from 5 to 15.5 feet bgs and submitted for analysis of TPH-diesel, TPH-motor-oil, PCBs, and PAHs. Five grab groundwater samples were collected from borings FOPLB111GB0100A, FOPLB111GB0101B, FOPLB111GB0101C, FOPLB111GB0101D, and FOPLB111GB0101F and submitted for analysis of TPH-diesel, TPH-motor-oil, and PAHs.

TPH-type soil staining and odor was observed, and organic vapors were detected at six borings during 2003. Observations noted during drilling at these locations are summarized in Table 3.13-1. These notes are documented on the lithologic logs for these borings, which are presented in Appendix B to this report.

TABLE 3.13-1

Significant Observations Made During Drilling at FOPL Segment H1/2/B111 in 2003
*Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL
Segments, Lennar Mare Island, Vallejo, California*

Location	Depth of Staining and/or Odor	Maximum PID reading and depth
FOPLB111GB0100A	7 to 10.5 feet bgs	31.2 ppm at 8 feet bgs
FOPLB111GB0101	4.5 to 7.5 feet bgs	45.9 ppm at 7.5 feet bgs
FOPLB111GB0101A	4.5 to 5 feet bgs	8.5 ppm at 4.5 feet bgs
FOPLB111GB0101B	5 to 9 feet bgs	249 ppm at 6 feet bgs
FOPLB111GB0101C	4.8 to 14 feet bgs	88 ppm at 8 feet bgs
FOPLB111GB0101D	5 to 9 feet bgs	175 ppm at 9 feet bgs

3.13.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAH contamination in soil and groundwater in the vicinity of FOPL segment H1/2/B111 were defined by sampling efforts

performed during recent and previous investigations of the FOPL. Thirty-two soil samples and nine groundwater samples were collected along this FOPL segment.

3.13.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons were detected at elevated concentrations in soil samples collected along and downgradient of FOPL segment H1/2/B111 during the FOPL investigation performed during 1998 and 1999, as well as the investigation performed in 2003. During the 1998 and 1999 pipeline removal activities, TPH-fuel-oil was detected in five of six soil samples at two locations at a maximum concentration of 3,900 mg/kg (location 114 from 5 feet bgs).

During the 2003 sampling event, three borings were advanced, and five soil samples were collected to confirm or refute the presence of previously detected TPH concentrations in soil at previous sample locations 082B, 082C, 082D, and 114.

FOPLB111GB0100 was advanced at the same location as sample 082A, 082B, 082C, and 082D to confirm or refute previously detected TPH-fuel-oil concentrations of 2,700 mg/kg at 8 feet bgs and 700 mg/kg at 11 feet bgs in 1998. A soil sample collected in 2003 at 8 feet bgs contained TPH-diesel and TPH-motor-oil at concentrations of 2,100 mg/kg and 1,800 mg/kg, respectively. Soil samples collected at 12 feet bgs did not contain TPH-diesel or TPH-motor-oil at concentrations above analytical reporting limits. Following this sampling event, additional soil samples were collected within 10 feet of FOPLB111GB0100 (at FOPLB111GB0100A) to delineate the extent of contamination in the downgradient direction. Soil samples collected at FOPLB111GB0100A at depths of 8 feet bgs did not contain TPH-diesel or TPH-motor-oil at concentrations above Tier 1 ESLs. These results indicate that contamination remains at previous sample locations 082B and 082C but that the lateral extent of soil contamination is defined in the downgradient direction.

FOPLB111GB0101 and FOPLB111GB0101A were advanced in 2003 at the same location as sample 114 to confirm or refute the presence of the previously detected TPH-fuel-oil concentration (3,900 mg/kg at 5 feet bgs in 1999). A soil sample collected at 5 feet bgs from FOPLB111GB0101 contained TPH-diesel and TPH-motor-oil at concentrations of 18,000 mg/kg and 15,000 mg/kg, respectively. Soil samples collected at 7.8 feet bgs contained TPH-diesel and TPH-motor-oil at concentrations of 3,100 mg/kg and 2,500 mg/kg, respectively. A soil sample collected at 10 feet bgs from FOPLB111GB0101A did not contain TPH-diesel or TPH-motor-oil above Tier 1 ESLs. These results indicate that petroleum hydrocarbons previously detected in sample 114 remain in the subsurface at this location but that the vertical extent of contamination is defined.

Additional soil samples were collected at locations approximately 15 feet and 30 feet upgradient and downgradient of FOPLB111GB0101 to delineate the extent of contamination detected at this location. These samples were collected along the previous location of FOPL segment H1/2/B111 at FOPLB111GB0101B, FOPLB111GB0101C, FOPLB111GB0101D, and FOPLB111GB0101E. As shown in Figure 3.8-1, TPH-diesel and TPH-motor-oil were detected at concentrations above Tier 1 ESLs from soil samples collected from each of these step-out locations. However, concentrations of TPH-diesel and TPH-motor-oil decrease with distance from the original sample location (FOPLB111GB0101), which is near the intersection of FOPL segments H1/2/B111 and H1/X/B207S. Elevated concentrations of petroleum

hydrocarbons extend laterally in soil at distances over 30 feet from the intersection of these segments. The remaining soil samples collected along FOPL segment H1/2/B111 contained petroleum hydrocarbons at concentrations below Tier 1 ESLs, suggesting that significant concentrations of petroleum hydrocarbons remain only in the vicinity of FOPLB111GB0100 and FOPLB111GB0101 and their associated step-out boring locations.

Xylene was the only BTEX compound detected at a concentration exceeding the analytical reporting limit in any of the samples for which BTEX compounds were analyzed. Xylene was detected in sample 114 but was not quantified at a concentration above the Tier 1 ESL (Figure 3.1-2). Several PAH compounds were detected in soil samples collected during the 2003 sampling event, as presented in Figure 3.1-3. Benzo(a)pyrene is the only PAH to be detected in these samples at a concentration exceeding the Tier 1 ESL (0.13 mg/kg). Benzo(a)pyrene was detected at a concentration of 0.55 mg/kg in sample collected from 5 feet bgs at FOPLB111GB0101. PCBs were not detected in the sample (FOPLB111GB0101G at 5 feet bgs) for which they were analyzed.

Previous investigations conducted in 1998 through 2003 detected concentrations of TPH-diesel, TPH-motor-oil, TPH-fuel-oil, and benzo(a)pyrene above Tier 1 ESLs for industrial sites. A Tier 2 risk analysis was performed for FOPL segment H1/2/B111, as presented in Appendix D. Tier 2 screening levels were developed in accordance with RWQCB guidance (RWQCB 2003) and based on site-specific conditions. The Tier 2 screening levels for TPH-diesel, TPH-fuel-oil, and TPH-motor-oil in surface and subsurface soil at FOPL segment H1/2/B111 is 10,000 mg/kg and the Tier 2 screening level for benzo(a)pyrene in surface soil is 1.3 mg/kg (Table 1.4-3). TPH-motor-oil and benzo(a)pyrene were not detected at concentrations exceeding these screening levels. The maximum residual concentration of TPH-middle-distillates, which comprises TPH-diesel and TPH-fuel-oil, in surface soil samples is 18,000 mg/kg. However, a statistical analysis (Appendix D), of the TPH-diesel and TPH-fuel-oil soil data collected for FOPL segment H1/2/B111 concluded that the EPC (95 percent UCL [bootstrap-t]) is approximately 4,000 mg/kg. Therefore, the EPC for TPH-middle-distillates does not exceed the Tier 2 screening level derived for these constituents.

3.13.4.2 Nature and Extent of Groundwater Contamination

Figure 3.8-1 presents locations where petroleum hydrocarbons were detected in groundwater in the vicinity of FOPL segment H1/2/B111. Five groundwater samples were collected in 2003 along or within 15 feet downgradient of FOPL segment H1/2/B111. TPH-diesel and TPH-motor-oil were detected above Tier 1 ESLs in four of the five grab groundwater samples (at sample locations FOPLB111GB0100A, FOPLB111GB0101B, FOPLB111GB0101C, and FOPLB111GB0101D). TPH-diesel and TPH-motor-oil were detected at maximum concentrations of 3,400 µg/L and 4,600 µg/L, respectively, in a sample collected from FOPLB111GB0101B. Lower concentrations of these compounds were detected in groundwater at locations upgradient and downgradient of FOPLB111GB0101B (Figure 3.8-1). The extent of groundwater contamination appears to be laterally defined by the nondetect results for TPH-diesel and TPH-motor-oil in a sample collected from FOPLB85SGB0103C, which is located approximately 30 feet northeast (downgradient) of the eastern end of FOPL segment H1/2/B111 (Figure 3.8-1).

All five grab groundwater samples collected along FOPL segment H1/2/B111 were analyzed for PAHs. As presented in Figure 3.1-3, fluorene, acenaphthylene, and acenaphthene were detected at low concentrations. PAH compounds were not detected above Tier 1 ESLs in any of the grab groundwater samples. The groundwater samples collected along FOPL segment H1/2/B111 were not analyzed for BTEX compounds.

Samples collected during the 2002-2003 FOPL investigation contained TPH-diesel and TPH-motor-oil in groundwater at concentrations above Tier 1 ESLs. Consequently, a Tier 2 risk analysis was performed for FOPL segment H1/2/B111, as presented in Appendix D. Tier 2 screening levels were developed in accordance with RWQCB guidance (RWQCB 2003) and based on site-specific conditions. The site-specific Tier 2 screening level for TPH-diesel and TPH-motor-oil in groundwater at FOPL segment H1/2/B111 is 50,000 µg/L (Table 1.4-4). Residual concentrations of TPH remaining in groundwater at FOPL segment H1/2/B111 are significantly below this Tier 2 screening level.

3.13.5 Conclusions

FOPL segment H1/2/B111 is appropriate for permanent closure. The entire length of FOPL segment H1/2/B111 was either removed or flushed. Prior to flushing, the segment passed a vacuum test; therefore, any source of potential soil and groundwater contamination from this segment has been removed or remediated.

This site has been adequately characterized. Forty-four soil samples were collected from 26 locations along this 497-foot span of FOPL between 1998 and 2003. While the analytical data suggest that previous releases from FOPL segment H1/2/B111 have resulted in petroleum hydrocarbon contamination to soil and groundwater, the results of a Tier 2 risk analysis indicate that concentrations remaining in soil and groundwater do not pose an unacceptable risk to human health or the environment. Tier 2 screening levels were derived for TPH-diesel, TPH-motor-oil, TPH-fuel-oil, and benzo(a)pyrene in soil and TPH-diesel and TPH-motor-oil in groundwater. The Tier 2 screening levels and EPCs for each COPC are presented in Tables 1.4-3 and 1.4-4. The EPC for each COPC is less than the corresponding Tier 2 screening level. Further, Mare Island Strait is located over 400 feet from FOPL segment H1/2/B111, and is therefore not expected to be impacted by immiscible, long-chained hydrocarbons in soil at the site. Analytical data for groundwater downgradient of FOPL segment H1/2/B111 indicate that constituents in groundwater are not migrating significant distances downgradient of the source of contamination.

Based on the analytical data and observations from subsurface investigations, this segment is not a threat to groundwater or surface water and presents no risk to human health or the environment. The segment is therefore a low-risk site and is appropriate for permanent closure.

3.14 FOPL Segments H1/2/B207B and H1/X/B87

3.14.1 Site Description

FOPL segments H1/2/B207B and H1/X/B87 are located in IA C1 in an area with a proposed mixed (industrial) land-use (Figure 2.2-2). FOPL segment H1/2/B207B has a 2-inch diameter and is 201 feet long. This FOPL segment was previously discussed and

recommended for closure in the *Draft Site Closure Summary Report for FOPL Segments G1/6/B829A&B, H1/2/B207B, I1/4/BE3BE8, and I1/4/B477 in Investigation Area C1* (CH2M HILL 2003h). The diameter of FOPL segment H1/X/B87 is unknown. This FOPL segment is approximately 52 feet long.

FOPL segments H1/2/B207B and H1/X/B87 extend adjacent to Nimitz Avenue from the intersection with FOPL segment G1/2/B207 to the intersection with FOPL segments H1/2/B111 and H1/2.5/CALIF, as presented in Figure 2.4-1. The depth at which these pipelines were buried is unknown, but is likely approximately 6 feet bgs based on the depth of intersecting pipelines. These FOPL segments are located at a surface elevation of approximately 17 feet msl and at a location approximately 500 feet away from Mare Island Strait, which is the closest surface water body. The groundwater flow direction is to the northeast towards the Strait (Figure 2.5-1). The FOPL segments are located within the original (1859) Mare Island boundary.

3.14.2 Previous Actions and Investigations

FOPL segments H1/2/B207B and H1/X/B87 have been included in two previous investigations between 1997 and 2001. During 1997 and 1998, the entire length of FOPL segment H1/2/B207B was removed from a sidewalk vault when the steam lines were installed in the area, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). No soil samples were collected along FOPL segment H1/2/B207B following removal of this pipeline. No attempt has been made to locate FOPL segment H1/X/B87. This FOPL segment was identified by CH2M HILL during a review of historical internal Navy maps in 2002.

From 1999 to 2001, 48 soil and four grab groundwater samples were collected from 24 borings located in vicinity of Building 207, as documented in the *Fuel Pipeline Investigation Status Report for Buildings 85, 207, 257, 386, 388, and 390* (TtEMI and Washington 2001). Four of the 24 borings (B207GB009, B207GB010, B207GB019, and B207GB020) were located in the vicinity of FOPL segments H1/2/B207B and H1/X/B87. Six soil samples were collected from B207GB010, B207GB019, and B207GB020 from 5 to 10.5 feet bgs. Grab groundwater samples were collected from B207GB010 and B207GB009. All samples were analyzed for TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX compounds.

3.14.3 2002-2003 FOPL Investigation

No action was performed to characterize contamination at FOPL segment H1/2/B207B during the 2002-2003 FOPL investigation. Closure of this FOPL segment was proposed in April 2003 in *Draft Site Closure Summary Report for FOPL Segments G1/6/B829A&B, H1/2/B207B, I1/4/BE3BE8, and I1/4/B477 in Investigation Area C1* (CH2M HILL 2003h). Three borings (FOPLB207SGB0102B, FOPLB207SGB0102C, and FOPLB207SGB0101B) were advanced downgradient of FOPL segment H1/2/B207B as part of the investigation of FOPL segment H1/X/B207S in 2003.

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment H1/X/B87 were required during the 2002-2003 FOPL investigation. In October 2002, a geophysical investigation was performed in an attempt to locate FOPL segment H1/X/B87

using GPR and metal-detection equipment. The results of the GPR survey are presented on Plate 24 in Appendix C. The FOPL was not located during this investigation, although the presence of many utilities and railroad tracks in the area made it difficult to identify the location of specific utilities. The results suggest that this FOPL segment is no longer present or never existed. To confirm that this pipeline did not historically release contaminants to the subsurface, a boring (FOPLB87GB0100) was advanced in May 2003, and two soil samples were collected at 5 and 12 feet bgs. The soil samples were submitted for analysis of TPH-diesel and TPH-motor-oil. Slight TPH-type odor was observed from 6.5 to 9 feet bgs during drilling operations at FOPLB87GB0100. Organic vapors were detected with a PID at a maximum concentration of 33.7 ppm (FOPLB87GB0100 from 11 feet to 12 feet bgs).

3.14.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAH contamination in soil and groundwater in the vicinity of FOPL segments H1/2/B207B and H1/X/B87 were defined by sampling efforts performed during recent and previous investigations of the FOPL. Sixteen soil samples and six groundwater samples were collected along these FOPL segments.

3.14.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons were detected at generally low concentrations in the vicinity of the FOPL segments H1/2/B207B and H1/X/B87, as shown in Figure 3.8-1. Soil samples collected at FOPLB87GB0100, located within 5 feet downgradient of the FOPL segment H1/X/B87, contained TPH-diesel and TPH-motor-oil at maximum concentrations of 150 mg/kg (12 feet bgs) and 250 mg/kg (12 feet bgs), respectively. FOPLB207AGB0101C was also advanced immediately downgradient of FOPL segment H1/X/B87. Samples collected from this boring also contained very low concentrations of petroleum hydrocarbons in soil.

Three of six soil samples associated with segment H1/2/B207B contained petroleum hydrocarbons at concentrations above analytical reporting limits. TPH-diesel was detected at a maximum concentration of 730 mg/kg in a sample collected from 9 feet bgs at FOPLB207GB0102B. TPH-motor-oil was detected at a maximum concentration of 820 mg/kg in a sample collected from 5 feet bgs at B207GB020 in 2000. As shown in Figure 3.8-1, elevated levels of petroleum hydrocarbons have been detected in soil northeast of Building 207 in the vicinity of FOPL segments H1/X/B207S and H1/2/B207A. Because FOPL segment H1/2/B207B was previously located in a utility vault, residual TPH concentrations in soil in the vicinity this FOPL segment are likely the result of contamination associated with releases from upgradient FOPL segment H1/X/B207S. Low concentrations of petroleum hydrocarbons have otherwise been detected in the vicinity of FOPL segment H1/2/B207B.

Figure 3.1-2 shows the results of BTEX analysis for soil samples collected in the vicinity of FOPL segment H1/2/B207B. Six samples collected from three locations in this area were analyzed for BTEX. BTEX compounds were not detected above analytical reporting limits in any of the samples. Soil samples collected from FOPLB207SGB0102B, FOPLB207SGB0102C, and FOPLB207SGB0101B were analyzed for PAHs. No PAHs were detected in any of these samples at concentrations exceeding the Tier 1 ESLs (Figure 3.1-2).

Although soil contamination detected downgradient of FOPL segment H1/2/B207B is presumed to be associated with previous releases of FOPL segment H1/X/B207S, a Tier 2 risk analysis was performed to address the elevated concentrations of TPH-diesel detected in soil at sample locations B207GB020 (in 2000) and FOPLB207SGB0102B (in 2003). The Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) and based on site-specific information. The Tier 2 screening level for TPH-diesel is 10,000 mg/kg (Table 1.4-3). TPH-diesel was detected at the site at concentrations significantly below this value.

3.14.4.2 Nature and Extent of Groundwater Contamination

The distribution of TPH compounds in groundwater samples collected in the vicinity of FOPL segment H1/2/B207B is presented in Figure 3.8-1. One grab groundwater sample collected at B207GB009 in December 1999, located 5 feet downgradient of FOPL segment H1/X/B87, contained TPH-motor-oil at a concentration of 330 µg/L. Xylene was also detected in this sample at a concentration of 1.5 µg/L. Elevated concentrations of TPH-diesel and TPH-motor-oil were detected in the grab groundwater sample collected from FOPLB207GB0101C in 2003 (1,200 µg/L and 1,000 µg/L, respectively). Fluorene was also detected in this sample at a concentration of 0.13 µg/L.

Of the four samples collected downgradient of FOPL segment H1/2/B207B, TPH-diesel, TPH-motor-oil, acenaphthene, chrysene, fluorene, and pyrene were detected at maximum concentrations of 2,200 µg/L, 1,300 µg/L, 0.2 µg/L, 0.15 µg/L, 0.8 µg/L, and 0.14 µg/L, respectively. TPH-diesel was detected at a concentration exceeding the Tier 1 ESL in one of four samples, and TPH-motor-oil was detected at concentrations exceeding the Tier 1 ESL in three of four groundwater samples. Because FOPL segment H1/2/B207B was previously located in a utility vault, elevated petroleum hydrocarbon concentrations in groundwater in the vicinity this FOPL segment are likely associated with previous releases from upgradient FOPL segment H1/X/B207S.

A Tier 2 risk analysis was performed due to elevated concentrations of TPH-diesel and TPH-motor-oil in groundwater at FOPL segments H1/2/B207B and H1/X/B87. The Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) and based on site specific information. The Tier 2 screening level for these COPCs is 50,000 µg/L (Table 1.4-4). The COPCs were detected at concentrations significantly below this Tier 2 screening level.

3.14.5 Conclusions

FOPL segments H1/2/B207B and H1/X/B87 are appropriate for permanent closure. The entire length of FOPL segment H1/2/B207B was removed from a concrete utility vault. A geophysical survey performed in 2002 indicates that FOPL segment H1/X/B87 is no longer present and may have never existed. In addition, FOPL segment H1/X/B87 was not located during removal of intersecting FOPL segments H1/2/B111, H1/2.5/CALIF, and H1/2/B207B. Therefore, any source of potential soil and groundwater contamination from these segments has been removed or remediated.

This site has been adequately characterized. Sixteen soil samples and six groundwater samples were collected in the vicinity of FOPL segments H1/2/B207B and H1/X/B87

between 1999 and 2003. Although elevated concentrations of TPH-diesel and TPH-motor-oil were detected in soil and groundwater in samples collected downgradient of FOPL segment H1/2/B207S and in groundwater downgradient of FOPL segment H1/X/B87, the results of a Tier 2 risk analysis indicate that these concentrations are not expected to pose a risk to human health or the environment. Elevated concentrations of petroleum hydrocarbons in soil and groundwater downgradient of FOPL segment H1/2/B207B are likely associated with previous releases from FOPL segment H1/X/B207S. Further, these FOPL segments are located approximately 300 feet away from Mare Island Strait. Petroleum hydrocarbons in groundwater at these sites will degrade through natural attenuation and are not expected to migrate over distances greater than 250 feet. Therefore, the constituents are not a threat to surface water. The FOPL segments are low-risk fuel sites and are appropriate for permanent closure.

3.15 FOPL Segment H1/2/B207A

3.15.1 Site Description

FOPL segment H1/2/B207A is located in an area of IA C1 with proposed mixed (industrial) land-use (Figure 2.2-2). FOPL segment H1/2/B207A has a 2-inch diameter and extends from within Building 207 to the intersection with FOPL segment H1/2/B111 (north of Building 207), as presented in Figure 2.4-1. This FOPL segment is 100 feet long and was present at approximately 4 to 7 feet bgs. This FOPL segment is located in an area with a surface elevation of 17 feet above msl. The FOPL segment is located approximately 570 feet from Mare Island Strait and is located within the original (1859) Mare Island boundary.

3.15.2 Previous Actions and Investigations

A field investigation was performed along FOPL segment H1/2/B207A in 1998, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). The entire 100-foot length of pipeline was removed. This pipeline was a converted sewer pipeline (Weston 2001). Four soil samples were collected along the removed portion of this segment following removal actions. These locations (104, 105, 106, and 107) are presented in Figure 3.8-1.

3.15.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment H1/2/B207A were required following the previous investigation. During June and July 2003, six borings (FOPLB207AGB0100, FOPLB207AGB0100A, FOPLB207AGB0101, FOPLB207AGB0101A, FOPLB207AGB0101B, and FOPLB207AGB0101C) were advanced to confirm that potential releases from this FOPL segment did not result in significant concentrations of petroleum hydrocarbons in the surrounding soil and groundwater. Soil samples were collected from these borings from 4 to 14 feet bgs and submitted for analysis of TPH-diesel, TPH-motor-oil, and PAHs. Four grab groundwater samples were collected at locations FOPLB207AGB0100A, FOPLB207AGB0101A, FOPLB207AGB0101B, and FOPLB207AGB0101C and submitted for analysis of TPH-diesel, TPH-motor-oil, and PAHs. Table 3.15-1 documents significant observations that were made during drilling at FOPLB207AGB0100A, FOPLB207AGB0101A, and FOPLB207AGB0101C. Hydrocarbon

staining and odors were not detected while drilling the remaining borings advanced during 2003.

TABLE 3.15-1

Significant Observations Made During Drilling at FOPL Segment H1/2/B207A in 2003

Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

Location	Depth of Staining and/or Odor	Maximum PID reading and depth
FOPLB207AGB0101	9 feet bgs	52.4 ppm at 9 feet bgs
FOPLB207AGB0101A	5 to 14 feet bgs	149 ppm at 7 feet bgs
FOPLB207AGB0101C	11 to 13 feet bgs	117 ppm at 13 feet bgs

3.15.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAH contamination in soil and groundwater in the vicinity of FOPL segment H1/2/B207A were defined by sampling efforts performed during recent and previous investigations of the FOPL. Eighteen soil samples and four groundwater samples were collected along this FOPL segment.

3.15.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons were detected at elevated concentrations in soil samples collected along and downgradient of FOPL segment H1/2/B207A during the FOPL investigations performed in 1998 and 2003. During 1998 pipeline removal activities, TPH-fuel-oil was detected in two of four soil samples at a maximum concentration of 6,200 mg/kg (sample 105).

During the 2003 sampling event, two borings were advanced, and soil samples were collected to confirm the presence of previously detected TPH concentrations in soil at previous sample locations 105 and 107.

FOPLB207AGB0100 was advanced at the same location as 105 to confirm or refute previously detected TPH concentrations at that location. A soil sample collected at 4 feet bgs contained TPH-diesel and TPH-motor-oil at concentrations of 570 mg/kg and 1,900 mg/kg, respectively. These results are lower than petroleum hydrocarbon concentrations previously detected at this location; TPH-fuel-oil was detected at a concentration of 6,200 mg/kg in sample 105 in 1998. These results indicate that previous results for sample 105 do not represent current site conditions. Analytical data for FOPLB207AGB0100 better represent the existing conditions at this location and are used to characterize contamination at the site. Soil samples were collected within 10 feet and downgradient of FOPLB207AGB0100 to define the extent of contamination. Soil samples collected at FOPLB207AGB0100A at 4 and 7 feet bgs did not contain TPH-diesel or TPH-motor-oil at concentrations above analytical reporting limits, indicating that the lateral extent of contamination at this location is defined. The vertical extent of contamination is also defined, as the sample collected at 7 feet bgs at FOPLB207AGB0100 only contained petroleum hydrocarbons at concentrations below the Tier 1 ESLs.

FOPLB207AGB0101 was advanced at approximately the same location as 107 to confirm or refute previously detected TPH concentrations at that location. A soil sample collected at

9 feet bgs contained TPH-diesel and TPH-motor-oil at concentrations of 1,300 mg/kg and 1,800 mg/kg, respectively. These results are similar to the concentration of TPH-fuel-oil detected in sample 107 in 1999 (1,900 mg/kg). Because TPH results from soil samples collected at FOPLB207AGB0101 and 107 have similar concentrations, analytical data for sample 107 will remain in the data set used to characterize contamination at FOPL segment H1/2/B207A. Soil samples were collected at locations approximately 15 feet (FOPLB207AGB0101A), 30 feet (FOPLB207AGB0101B), and 60 feet (FOPLB207AGB0101C) downgradient of FOPLB207AGB0100 to define the extent of contamination in this area. Elevated concentrations of TPH-diesel and TPH-motor-oil were detected at concentrations up to 3,100 mg/kg and 3,000 mg/kg, respectively, in samples collected from FOPLB207AGB0101A and FOPLB207AGB0101B. Elevated concentrations were not detected at FOPLB207GB0101C, indicating that the lateral extent of soil contamination is defined in the downgradient direction. Elevated concentrations of petroleum hydrocarbons extend no further than 60 feet downgradient of the source of contamination.

Four soil samples collected along FOPL segment H1/2/B207A were submitted for analysis of BTEX compounds (Figure 3.1-2). BTEX compounds were only detected in sample 107. Ethylbenzene and xylene detected in 107 were not quantified at concentrations above Tier 1 ESLs. Six soil samples collected during 2003 were submitted for analysis of PAHs. PAH compounds were detected in each of the soil samples collected during the 2003 sampling event, as presented in Figure 3.1-3. However, all PAHs were detected at concentrations below their respective Tier 1 ESLs.

Soil samples collected during previous investigations conducted in 1998 and 2003 contained TPH-diesel, TPH-motor-oil, and TPH-fuel-oil at concentrations above Tier 1 ESLs. Based on these results, a Tier 2 risk analysis was performed for FOPL segment H1/2/B207A, as presented in Appendix D. Tier 2 screening levels were developed in accordance with RWQCB guidance (RWQCB 2003) and based on site-specific information. The Tier 2 screening level for the COPCs in surface and subsurface soil at FOPL segment H1/2/B207A is 10,000 mg/kg (Table 1.4-3). Residual concentrations of petroleum hydrocarbons remaining in soil at FOPL segment H1/2/B207A are significantly below this Tier 2 screening level, indicating that previous releases from this FOPL segment do not pose an unacceptable risk to human health or the environment.

3.15.4.2 Nature and Extent of Groundwater Contamination

Four grab groundwater samples were collected along and downgradient of FOPL segment H1/2/B207A at locations presented in Figure 3.8-1. The groundwater sample collected at FOPLB207AGB0100A did not contain TPH-diesel, TPH-motor-oil, or PAHs above analytical reporting limits. Three groundwater samples collected downgradient of 107 and FOPLB207AGB0101 contained elevated concentrations of TPH-diesel, TPH-motor-oil, and PAH compounds. TPH-diesel and TPH-motor-oil were detected at maximum concentrations of 7,800 µg/L and 5,700 µg/L, respectively, in a sample collected from FOPLB207AGB0101B in 2003. TPH-diesel and TPH-motor-oil were detected at concentrations of 1,200 µg/L and 1,000 µg/L, respectively, in a sample collected from FOPLB207AGB0101C, which is located approximately 30 feet downgradient of FOPLB207AGB0101B. This result suggests that petroleum hydrocarbon concentrations are declining with distance from the FOPL segment.

Several PAH compounds were detected in groundwater samples collected in the vicinity of FOPL segment H1/2/B207A. Chrysene and fluorene were the only PAHs detected in groundwater at concentrations exceeding the respective Tier 1 ESLs. These PAHs were detected at concentrations (1 µg/L and 5.3 µg/L, respectively) exceeding Tier 1 ESLs (0.35 µg/L and 3.9 µg/L, respectively) in the groundwater sample collected at FOPLB207AGB0101B. Chrysene was not detected in the sample collected downgradient of FOPLB207AGB0101B, and fluorene was detected at a significantly lower concentration (0.13 µg/L) in the downgradient sample. These results indicate that the lateral extent of PAH contamination in groundwater is defined in the downgradient direction.

Groundwater samples collected during the 2002-2003 FOPL investigation contained concentrations of TPH-diesel, TPH-motor-oil, chrysene, and fluorene above Tier 1 ESLs. Based on this data, a Tier 2 risk analysis was performed for FOPL segment H1/2/B207A, as presented in Appendix D. Tier 2 screening levels were developed in accordance with RWQCB guidance (RWQCB 2003) and based on site-specific information. The Tier 2 screening level for TPH-diesel, TPH-motor-oil, and chrysene in groundwater at FOPL segment H1/2/B207A is 50,000 µg/L, and the Tier 2 screening level for fluorene in groundwater is 1,900 µg/L (Table 1.4-4). Existing concentrations of petroleum hydrocarbons and PAHs remaining in groundwater at FOPL segment H1/2/B207A are significantly below these Tier 2 screening levels.

3.15.5 Conclusions

FOPL segment H1/2/B207A is appropriate for permanent closure. The entire length of FOPL segment H1/2/B207A was removed. Therefore, any source of potential soil and groundwater contamination from these segments has been removed or remediated.

This site has been adequately characterized. Eighteen soil samples and four groundwater samples were collected along this 100-foot span of FOPL in 1998 and 2003. While analytical data indicate that a release has occurred from this FOPL segment, the results of a Tier 2 risk analysis indicate that contamination associated with this FOPL segment does not pose an unacceptable risk to human health or the environment. Tier 2 screening levels were developed for TPH-diesel, TPH-motor-oil, and TPH-fuel-oil in soil and TPH-diesel, TPH-motor-oil, chrysene, and fluorene in groundwater and are presented in Tables 1.4-3 and 1.4-4. All COPCs were detected at concentrations significantly below the corresponding Tier 2 screening level. Additionally, this site is located approximately 570 feet from Mare Island Strait. It is expected that petroleum hydrocarbons in soil and groundwater will naturally attenuate and will not be discharged to the Strait.

Based on the analytical data and observations from subsurface investigations, FOPL segment H1/2/B207A is not a threat to groundwater or surface water and presents no risk to human health or the environment. The segment is therefore a low-risk site and is appropriate for permanent closure.

3.16 FOPL Segment H1/2.5/CALIF

3.16.1 Site Description

FOPL segment H1/2.5/CALIF is located in an area of IA C1 with proposed mixed (industrial) land-use (Figure 2.2-2). FOPL segment H1/2.5/CALIF has 2.5-inch diameter and extends along the entire west side of Building 87, as presented in Figure 2.4-1. This FOPL segment is 383 feet long and is present at approximately 5 to 6 feet bgs. The FOPL segment is located approximately 500 feet from Mare Island Strait and is located within the original (1859) Mare Island boundary. This FOPL segment is located in an area with a surface elevation of 15 to 16 feet above msl.

A cistern (Cistern 87) located adjacent to FOPL segment H1/2.5/CALIF was identified from historical maps of Mare Island as 120,000-gallon Water Cistern No. 2. This cistern was depicted on maps to be directly beneath Nimitz Avenue, adjacent to the west side of Building 87. A limited investigation of this UST was performed to determine if there was a release to the environment. The results of this investigation are documented in *Request for Closure of Previously Unidentified Cistern 87 in Investigation Area C1* (CH2M HILL 2003i).

3.16.2 Previous Actions and Investigations

Three previous actions have been performed in the vicinity of FOPL segment H1/2.5/CALIF between 1997 and 2003. During 1997 and 1998, all 383 feet of FOPL segment H1/2.5/CALIF were removed from the sidewalk vault in which the pipeline was located at the time the steam lines were installed, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). No soil samples were collected along the removed portion of this segment following pipeline removal.

From 1999 to 2001, 48 soil and four grab groundwater samples were collected from 24 borings located in vicinity of Building 207, as documented in the *Fuel Pipeline Investigation Status Report for Buildings 85, 207, 257, 386, 388, and 390* (TtEMI and Washington 2001). The purpose of this investigation was to locate underground fuel lines and associated leaks, characterize the horizontal and vertical extent of soil and groundwater contamination, and identify and locate any additional sources of contamination. One of the 24 borings (B207GB008) was located in the vicinity of FOPL segment H1/2.5/CALIF. Soil samples were collected from this boring at 5 and 9 feet bgs and analyzed for TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX compounds. This investigation concluded that further investigation and sampling was required to assess the extent of TPH contamination in soil and groundwater at the Building 207 Area.

Two soil borings were advanced at the location of Cistern 87 in March 2003 as part of a limited investigation of this cistern. Groundwater samples were collected from each boring. One groundwater sample (C87GB103) was collected from a location suspected of being immediately downgradient of FOPL segment H1/2.5/CALIF. This sample was submitted for analysis of TPH-gasoline, TPH-diesel, TPH-motor-oil, BTEX compounds, and MTBE (CH2M HILL 2003i).

3.16.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment H1/2.5/CALIF were required following the previous investigations. During June 2003, four borings (FOPLCALIFGB0100, FOPLCALIFGB0101, FOPLCALIFGB0102, and FOPLCALIFGB0103) were advanced to confirm that potential releases from this FOPL segment did not result in significant concentrations of petroleum hydrocarbons in the surrounding soil. Soil samples were collected at intervals of approximately 100 feet at locations immediately downgradient of the former location of the pipeline. Eight soil samples were collected from the four boring locations at 5 and 12 feet bgs and submitted for analysis of TPH-diesel and TPH-motor-oil. No unusual visual or olfactory observations were made during operations, and organic vapors were not detected with a PID.

3.16.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon and BTEX contamination in soil and groundwater in the vicinity of FOPL segment H1/2.5/CALIF were defined by sampling efforts performed during recent and previous investigations of the FOPL. Ten soil samples and one groundwater sample were collected along this FOPL segment. No samples have been submitted for analysis of PAHs along this FOPL segment.

3.16.4.1 Nature and Extent of Soil Contamination

With exception to an elevated concentration of TPH-fuel-oil detected in a sample collected at 9 feet bgs from B207GB008, petroleum hydrocarbons were detected at low concentrations in soil in the vicinity of the FOPL segment H1/2.5/CALIF, as shown in Figure 3.8-1. TPH-fuel-oil was detected at a concentration of 3,800 mg/kg from B207GB008 at 9 feet bgs in December 1999. This sample was also analyzed for BTEX compounds. Ethylbenzene was detected at a concentration of 0.082 mg/kg and xylene at a concentration of 0.036 mg/kg. These concentrations are below the corresponding Tier 1 ESLs.

A Tier 2 risk analysis was performed for FOPL segment H1/2.5/CALIF due to the elevated concentration of TPH-fuel-oil detected in one soil sample along this FOPL segment. A Tier 2 screening level was derived for TPH-fuel-oil (a petroleum hydrocarbon middle-distillate) at this location in accordance with RWQCB guidance (RWQCB 2003) and based on site-specific conditions. The methodology used to perform the Tier 2 risk analysis is presented in Appendix D. The site-specific Tier 2 screening level for TPH-fuel-oil in soil at FOPL segment H1/2.5/CALIF is 10,000 mg/kg. Residual concentrations of petroleum hydrocarbons remaining in soil at FOPL segment H1/2.5/CALIF are significantly below this Tier 2 screening level. TPH-fuel-oil in soil is therefore not expected to pose a risk to human health or the environment at this site.

3.16.4.2 Nature and Extent of Groundwater Contamination

One groundwater sample has been collected within 5 feet downgradient of FOPL segment H1/2.5/CALIF. The groundwater sample was collected from C87GB103 in March 2003 to determine if groundwater is impacted by a suspect cistern (Cistern 87). TPH-diesel and TPH-motor-oil were detected at this location at concentrations of 1,100 µg/L and 1,500 µg/L, respectively. These concentrations are greater than the Tier 1 ESL for these

compounds (640 µg/L). In the closure letter prepared for Cistern 87, these elevated groundwater levels were determined to be attributed to a release other than from the cistern (CH2M HILL 2003i). BTEX compounds were not detected above analytical reporting limits in this sample.

A Tier 2 risk analysis was performed for FOPL segment H1/2.5/CALIF based on the elevated TPH-diesel and TPH-motor-oil concentrations detected in groundwater downgradient of this FOPL segment, as presented in Appendix D. The site-specific Tier 2 screening level for TPH-diesel and TPH-motor-oil in groundwater at FOPL segment H1/2.5/CALIF is 50,000 µg/L. Residual concentrations of TPH remaining in groundwater at FOPL segment H1/2.5/CALIF are significantly below this Tier 2 screening level.

3.16.5 Conclusions

FOPL segment H1/2.5/CALIF is appropriate for permanent closure. The entire length of this segment has been removed. Therefore, any source of potential soil and groundwater contamination from this segment has been removed or remediated.

This site has been adequately characterized. Ten soil samples and one groundwater sample were collected from six locations along this 383-foot span of FOPL in 1999 and 2003. A Tier 2 risk analysis was performed for the segment due to the presence of elevated TPH-fuel-oil concentrations in soil and elevated TPH-diesel and TPH-motor-oil concentrations in groundwater. The Tier 2 risk analysis is presented in Appendix D. The results of this analysis indicate that the residual concentrations of petroleum hydrocarbons remaining in soil and groundwater are significantly below the corresponding Tier 2 screening levels. In addition, the FOPL segment is located approximately 300 feet away from Mare Island Strait, and any petroleum hydrocarbons in groundwater at this location are expected to naturally attenuate before migrating downgradient to the Strait.

Based on the analytical data and observations from subsurface investigations, this segment is not a threat to groundwater or surface water and presents no risk to human health or the environment. The segment is therefore a low-risk site and is appropriate for permanent closure.

3.17 FOPL Segment H1/2/B85S

3.17.1 Site Description

FOPL segment H1/2/B85S is located in an area of IA C1 with a proposed mixed (industrial) land-use (Figure 2.2-2). FOPL segment H1/2/B85S has a 2-inch diameter and extends 310 feet along the south side of Building 85 to the intersection with FOPL segments H1/2/B111 and H1/6/B85, as presented in Figure 2.4-1. Building 85 was built in 1858 and used as foundry storage (TtEMI and Washington 2001). This pipeline was likely located at approximately 3 feet bgs based on the depth of the intersecting FOPL segments.

The eastern end of the FOPL segment is approximately 110 feet away from Mare Island Strait. Groundwater flows to the northeast towards Mare Island Strait (Figure 2.5-1). The western portion of this FOPL segment is located within the original (1859) Mare Island

boundary, and the eastern portion of this FOPL segment is located in fill material. This FOPL segment is located in an area with a surface elevation of 12 to 16 feet above msl.

3.17.2 Previous Actions and Investigations

A field investigation was performed along this segment of the FOPL during 1996 and 1997, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). A geophysical survey was performed, and an exploratory trench was advanced at the intersection of FOPL segments H1/2/B85S, H1/6/B85, and H1/2/B111 during this investigation. FOPL segment H1/2/B85S was not located using GPR or exploratory trenching.

During investigations of the FOPL performed in 1999 through 2001, two borings (B085GB003 and B085GB010) were advanced in the vicinity of FOPL segment H1/2/B85S, as documented in the *Fuel Pipeline Investigation Status Report for Buildings 85, 207, 257, 386, 388, and 390* (TtEMI and Washington 2001). This investigation was initiated after the excavation and removal of portions of FOPL segment H1/2/B111 identified numerous small holes in several sections of the piping and staining within the excavation trench (Weston 2001). Two soil samples were collected from each boring from 5 to 11 feet bgs. A groundwater sample was also collected from B085GB010. Samples were analyzed for TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX compounds.

3.17.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment H1/2/B85S were required following the previous investigations. In October 2002, a geophysical investigation was performed in an attempt to locate the western end of FOPL segment H1/2/B85S and southern end of H1/6/B85 using GPR and metal-detection equipment. The results of the GPR survey are presented on Plate 43 in Appendix C. Neither of the FOPL segments were located during this investigation. These data suggest that FOPL segment H1/2/B85S is no longer present or never existed.

In June 2003, exploratory trenching was performed at the intersection of FOPL segments H1/2/B85S, H1/2/B111, and H1/6/B85. The trench was approximately 15.5 feet long and 4 feet wide and was positioned diagonally across FOPL segment H1/2/B85S. Previously flushed FOPL segment H1/2/B111 and previously non-located FOPL segment H1/6/B85 were observed in the trench at approximately 3 feet bgs. The extent of the excavation was increased approximately 12 feet to the east to ensure that FOPL segment H1/2/B111 did not continue (as FOPL segment H1/2/B85S) in this direction. However, FOPL segment H1/2/B85S was not located. Two soil samples were collected from the trench (FOPLB85SSS0100 from 3 and 4 feet bgs) and submitted for analysis of TPH-diesel and TPH-motor-oil. The sample collected from 4 feet bgs was also analyzed for PAHs. The sample collected from 4 feet bgs was collected from visibly stained soil.

During June 2003, three borings (FOPLB85SGB0100, FOPLB85SGB0101, and FOPLB85SGB0102) were advanced to confirm that potential releases from this FOPL segment did not result in significant concentrations of petroleum hydrocarbons in the surrounding soil and groundwater and to satisfy the requirement that samples be collected

at intervals of at least 100 feet along the FOPL. Four additional borings (FOPLB85SGB0103A, FOPLB85SGB0103B, FOPLB85SGB0103C, and FOPLB85SGB0103D) were advanced between July and October 2003 to delineate elevated concentrations of TPH-diesel and TPH-motor-oil detected in soil samples collected from the exploratory trench located at FOPLB85SSS0100 (see Section 3.17.4). Twelve soil samples were collected from the seven boring locations at 4 feet to 14 feet bgs. The samples were submitted for analysis of TPH-diesel, TPH-motor-oil, and, in some cases, PAHs. Three grab groundwater samples were collected from borings FOPLB85SGB0101, FOPLB85SGB0103B, and FOPLB85SGB0103C and submitted for analysis of TPH-diesel, TPH-motor-oil, and PAHs. Significant observations made during drilling operations were recorded on lithologic logs (Appendix B) and are summarized in Table 3.17-1.

TABLE 3.17-1

Significant Observations Made During Drilling at FOPL Segment H1/6/B85S in 2003

Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

Location	Depth of Staining and/or Odor	Maximum PID reading and depth
FOPLB85SGB0103A	5 to 9 feet bgs	135 ppm at 9 feet bgs
FOPLB85SGB0103B	2 to 14.5 feet bgs	193 ppm at 2 feet bgs
FOPLB85SGB0103C	4 to 8 feet bgs	167 ppm at 4 feet bgs

3.17.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAH contamination in soil and groundwater in the vicinity of FOPL segment H1/2/B85S were defined by sampling efforts performed during recent and previous investigations of the FOPL. Eighteen soil samples and four groundwater samples were collected along this FOPL segment.

3.17.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons were detected in soil at elevated concentrations in the vicinity of FOPL segment H1/2/B85S, as shown in Figure 3.8-1. Six soil samples contained petroleum hydrocarbons at concentrations exceeding Tier 1 ESLs. TPH-diesel and TPH-motor-oil were detected at maximum concentrations of 14,000 mg/kg and 11,000 mg/kg, respectively, from FOPLB85SSS0100 at 4 feet bgs in June 2003. This sample location is at the intersection of FOPL segments H1/2/B85S, H1/6/B85, and H1/2/B111 and approximately 3 feet below the depth of these FOPL segments. Analytical data for step-out soil samples collected between 10 and 50 feet downgradient of FOPLB85SSS0100 suggest that hydrocarbons were previously released at the intersection of the three FOPL segments at sample location FOPLB85SSS0100. Petroleum hydrocarbon concentrations decrease with distance from the intersection of these three FOPL segments (Figure 3.8-1). TPH-diesel and TPH-motor-oil were detected at concentrations below Tier 1 ESLs in the sample collected approximately 50 feet downgradient from the intersection of the three FOPL segments, indicating that the lateral extent of contamination is defined in the downgradient direction.

Three soil samples collected from three sample locations (FOPLB85SSS0100, FOPLB85SGB0103A, and FOPLB85SGB0103B) at 4 and 9 feet bgs were analyzed for PAHs. Benzo(a)pyrene was the only PAH compound detected at a concentration exceeding the Tier 1 ESL (Figure 3.1-3). Benzo(a)pyrene was detected at a maximum concentration of

0.74 mg/kg at 9 feet bgs in FOPLB85SGB0103A. The sample collected from 4 feet bgs at FOPLB85SGB0103B also contained benzo(a)pyrene at a concentration exceeding the Tier 1 ESL (0.15 mg/kg). BTEX compounds were not detected above analytical reporting limits in the two soil samples for which they analyzed (Figure 3.1-2).

TPH-diesel, TPH-motor-oil, and benzo(a)pyrene have been detected at concentrations above Tier 1 ESLs in soil samples collected along FOPL segment H1/2/B85S. Based on these results, a Tier 2 risk analysis was performed for FOPL segment H1/2/B85S. The methodology for deriving the Tier 2 screening levels at FOPL segment H1/2/B85S is provided in Appendix D. Tier 2 screening levels were derived based on site-specific conditions and in accordance with RWQCB guidance (RWQCB 2003). The Tier 2 screening level for TPH-diesel and TPH-motor-oil is 10,000 mg/kg (Table 1.4-3). The maximum residual TPH-diesel and TPH-motor-oil concentrations detected at the FOPL segment are 14,000 mg/kg and 13,000 mg/kg, respectively. However, a statistical analysis of the TPH-middle-distillates (including TPH-diesel and TPH-fuel-oil) and TPH-residual-fuels (TPH-motor-oil) soil data collected along FOPL segment H1/2/B85S concluded that the EPCs (95 percent UCL [bootstrap-t]) for these hydrocarbon ranges are approximately 8,900 mg/kg and 5,800 mg/kg, respectively. The EPCs of TPH-diesel and TPH-motor-oil remaining in surface soil at FOPL segment H1/2/B85S are therefore below the corresponding Tier 2 screening level. Residual concentrations of benzo(a)pyrene remaining in soil at FOPL segment H1/2/B85S are below the Tier 2 screening level of 1.3 mg/kg.

3.17.4.2 Nature and Extent of Groundwater Contamination

Four groundwater samples were collected along segment H1/2/B85S in 2000 and 2003. TPH-diesel and TPH-motor-oil were detected above Tier 1 ESLs (at concentrations of 1,600 µg/L and 1,100 µg/L, respectively) in a groundwater sample collected from FOPLB85SGB0103B (Figure 3.8-1). All other groundwater samples collected along FOPL segment H1/2/B85S, including FOPLB85SGB0103C, which is located 15 feet downgradient of FOPLB85SGB0103B, did not contain TPH-diesel and TPH-motor-oil above analytical reporting limits. These results suggest that elevated concentrations of petroleum hydrocarbons along FOPL segment H1/2/B85S are limited to the area immediately downgradient of the intersection of FOPL segments H1/2/B85S, H1/2/B111, and H1/6/B85. The source of this groundwater contamination is considered to be a historical release from the intersection of these three FOPL segments. This source is located approximately 400 feet away from Mare Island Strait. Petroleum hydrocarbons in groundwater at this location are expected to degrade through natural attenuation before migrating downgradient to the Strait.

Three grab groundwater samples collected along FOPL segment H1/2/B85S were analyzed for PAHs (Figure 3.1-3). PAHs were not detected above Tier 1 ESLs in any of the samples. Ethylbenzene and toluene were detected at low concentrations in the one groundwater sample for which BTEX compounds were analyzed (B085GB010) (Figure 3.1-2).

A Tier 2 risk analysis was performed for FOPL segment H1/2/B85S, as presented in Appendix D, due to the elevated TPH-diesel and TPH-motor-oil concentrations detected in the sample collected from FOPLB85SGB0103B. The site-specific Tier 2 screening level for TPH-diesel and TPH-motor-oil in groundwater at FOPL segment H1/2/B85S is 50,000 µg/L

(Table 1.4-4). Residual concentrations of TPH remaining in groundwater at FOPL segment H1/2/B85S are significantly below this Tier 2 screening level.

3.17.5 Conclusions

FOPL segment H1/2/B85S is appropriate for permanent closure. This pipeline is no longer present, as indicated by results of a geophysical survey and exploratory trenching performed in 2003. The source of potential soil and groundwater contamination has therefore been removed.

This site has been adequately characterized. Eighteen soil samples and four groundwater samples were collected from 10 locations along this 310-foot span of FOPL. Elevated concentrations of petroleum hydrocarbons and benzo(a)pyrene have been detected at and up to approximately 30 feet downgradient of the intersection of FOPL segments H1/2/B85S, H1/6/B85, and H1/2/B111. While the analytical data suggest that a release has occurred to soil and groundwater in the vicinity of this FOPL segment, a Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) to evaluate the potential risk from TPH-diesel, TPH-motor-oil, and benzo(a)pyrene in soil and TPH-diesel and TPH-motor-oil in groundwater. The Tier 2 screening levels for these analytes in soil and groundwater are presented in Tables 1.4-3 and 1.4-4, respectively. The EPCs for each of these analytes is below the corresponding Tier 2 screening level.

The source of groundwater contamination at the site is located approximately 400 feet away from Mare Island Strait, which is the closest surface water body. Petroleum hydrocarbons in groundwater are expected to naturally attenuate before migrating this distance towards the Strait. Therefore, previous releases from the intersection of FOPL segments H1/2/B85S, H1/6/B85, and H1/2/B111 are not expected to impact surface water. Further, a baseline ERA concluded that constituents in groundwater at FOPL segment H1/2/B85S do not pose a significant risk to aquatic organisms in the Strait. The methodology behind and results of the Baseline ERA are provided in Attachment D1 of Appendix D.

Based on the results of the Tier 2 risk analysis, which considers the results of the baseline ERA and an evaluation on the degradation of surface water bodies, this site is not a threat to groundwater or surface water and presents no significant risk to human health or to the environment. The segment is a low-risk fuel site and is appropriate for permanent closure.

3.18 FOPL Segment H1/2/B271

3.18.1 Site Description

FOPL segment H1/2/B271 is located in areas of IA C1 with proposed mixed (industrial) land use (Figure 2.2-2). FOPL segment H1/2/B271 has a 2-inch diameter and is part of a network of piping extending beneath Buildings 85, 271, 89, and 91 (Figure 2.4-1). FOPL segment H1/2/B271 is suspected of being present beneath Building 271, which was used for storage and was constructed in 1918 (CH2M HILL 2002e). This FOPL segment is approximately 145 feet and intersects with FOPL segment H1/6/B85 at its western end. The FOPL segment may have been located at approximately 3 feet bgs, based on information on the depth of FOPL segment H1/6/B85.

The eastern end of this FOPL segment is located approximately 275 feet away from Mare Island Strait, which is the nearest surface water body. Groundwater at this location flows to the northeast towards the Strait (Figure 2.5-1). This FOPL segment is located in an area with a surface elevation of 16 feet above msl. This area is located within the original (1859) Mare Island boundary.

3.18.2 Previous Actions and Investigations

An attempt to locate FOPL segment H1/2/B271 using GPR and exploratory trenching was made during an investigation of the FOPL performed during 1998, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). The pipeline was not located during this investigation, which suggests that this pipeline is no longer present. (The exploratory trench was advanced at the suspected location where FOPL segments H1/6/B85 and H1/2/B271 intersected. However, a review of historical Navy maps subsequent to this investigation suggests that FOPL segment H1/2/B271 may be present further south of the location of the exploratory trench advanced in 1998.) Six soil samples (093, 093A, 093B, 093C, 093D, and 093E) were collected from the exploratory trench from 7 to 9 feet bgs to characterize contamination at this location. These sample depths are below the suspected former depth of this pipeline. Soil samples were analyzed for TPH-fuel-oil.

3.18.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment H1/2/B271 were required following the previous investigation. During October 2003, one boring (FOPLB271GB0100A) was advanced to determine if potential releases from this suspect FOPL segment had resulted in significant concentrations of petroleum hydrocarbons in the surrounding soil. Two soil samples were collected from the boring location at 7 feet and 10 feet bgs and submitted for analysis of TPH-diesel and TPH-motor-oil. The sample collected from 7 feet bgs was also analyzed for PAHs. A grab groundwater sample was collected from this location and submitted for analysis of TPH-diesel, TPH-motor-oil and PAHs. Slight hydrocarbon soil staining and odor were observed at boring FOPLB271GB0100A at 6 to 9 feet bgs during drilling operations, as presented in the lithologic log for this boring (Appendix B).

3.18.4 Nature and Extent of Soil and Groundwater Contamination

Seven soil samples and one groundwater sample have been collected along the suspected location of FOPL segment H1/2/B271. A discussion on the nature and extent of constituents detected in these samples is presented below. Soil and groundwater samples collected along this FOPL segment have not been analyzed for BTEX compounds.

3.18.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons were detected in soil at elevated concentrations in the vicinity of the FOPL segment H1/2/B271, as shown in Figure 3.8-1. Six soil samples contained petroleum hydrocarbons at concentrations exceeding Tier 1 ESLs. Five (093A, 093B, 093C, 093D, and 093E) of the six soil samples were collected from the same location between 7 and 9 feet bgs. The maximum TPH-fuel-oil concentration detected at this location was 7,300 mg/kg at 7 feet bgs. Lower concentrations of TPH-fuel-oil (2,300 to 4,000 mg/kg) were

detected in samples collected from 8 feet bgs, indicating that concentrations are decreasing with depth. TPH-diesel and TPH-motor-oil were detected at concentrations of 2,000 mg/kg and 1,500 mg/kg, respectively, in samples collected at 7 feet bgs from FOPLB271GB0100A. A soil sample collected from 10 feet bgs at the same location did not contain TPH-diesel and TPH-motor-oil at concentrations above Tier 1 ESLs. Petroleum hydrocarbons have not been detected east of this location, indicating that contamination at this location is vertically, but not laterally, defined.

The soil sample collected at FOPLB271GB0100A at 7 feet bgs was analyzed for PAHs; PAHs were not detected above Tier 1 ESLs in this sample (Figure 3.1-3).

A Tier 2 risk analysis was performed for FOPL segment H1/2/B271 due to the presence of elevated concentrations of petroleum hydrocarbons in soil. The methodology used in performing the Tier 2 risk analysis is presented in Appendix D. The site-specific Tier 2 screening level for TPH-diesel, TPH-fuel-oil, and TPH-motor-oil in soil at FOPL segment H1/2/B271 is 10,000 mg/kg (Table 1.4-3). Residual concentrations of TPH remaining in soil at FOPL segment H1/2/B271 are below this Tier 2 screening level.

3.18.4.2 Nature and Extent of Groundwater Contamination

One groundwater sample collected along the FOPL segment contained TPH-diesel and TPH-motor-oil above Tier 1 ESLs. TPH-diesel and TPH-motor-oil were detected at concentrations of 5,800 µg/L and 2,000 µg/L, respectively, in the groundwater sample collected from FOPLB271GB0100A in 2003. FOPLB271GB0100A is located within 10 feet of the suspected location of FOPL segment H1/2/B271 and near the mid-point of this FOPL segment. No other groundwater samples have been collected downgradient of FOPLB271GB0100A, indicating that the extent of groundwater contamination has not been defined in the lateral direction. However, the source of contamination (the FOPL) is more than 250 feet from the Strait. Because of the immobility and highly biodegradable nature of TPH and related compounds, an impact to surface water from sites located more than 250 feet from a surface-water body is not likely to occur. Therefore, previous releases of petroleum hydrocarbons from FOPL segment H1/2/B271 are not expected to result in a discharge of constituents to Mare Island Strait. The groundwater sample was also analyzed for PAHs. No PAHs were detected at concentrations above analytical reporting limits.

Due to the elevated concentrations of TPH-diesel and TPH-motor-oil detected in groundwater at the site, a Tier 2 risk analysis was performed for this FOPL segment. The methodology used in the Tier 2 risk analysis is presented in Appendix D. The site-specific Tier 2 screening level for TPH-diesel and TPH-motor-oil in groundwater at FOPL segment H1/2/B271 is 50,000 µg/L (Table 1.4-4). Residual concentrations of TPH remaining in groundwater at FOPL segment H1/2/B271 are significantly below this Tier 2 screening level.

3.18.5 Conclusions

FOPL segment H1/2/B271 is appropriate for permanent closure. This FOPL segment was not located during geophysical testing and exploratory trenching performed during previous investigations, suggesting that the FOPL no longer exists at this location. The source of potential soil and groundwater contamination has therefore been removed.

This site has been adequately characterized. Seven soil samples were collected from two locations in the vicinity of this 145-foot span of FOPL in 1998 and 2003. While the analytical data suggest that a release has occurred to soil in the vicinity of FOPL segment H1/2/B271, the results of a Tier 2 risk analysis indicate that elevated concentrations of TPH-diesel, TPH-fuel-oil, and TPH-motor-oil in soil and TPH-diesel and TPH-motor-oil in groundwater do not pose a risk at the site to human health or the environment and do not pose a threat to surface water or groundwater. All constituents were detected at concentrations less than the corresponding Tier 2 screening levels. The FOPL segment is located approximately 275 feet from Mare Island Strait and petroleum hydrocarbons released to the environment are expected to degrade before migrating downgradient to the Strait. Therefore, FOPL segment H1/2/B271 is a low-risk fuel site and is appropriate for permanent closure.

3.19 FOPL Segment I1/4/BE3BE8

3.19.1 Site Description

FOPL segment I1/4/BE3BE8 has a 4-inch diameter and is located in the northeast portion of IA C1. This segment is part of a “supply and return” pipeline that, in conjunction with FOPL segments G1/4/BE3BE8 and H1/4/BE3BE8, was used to transport fuel oil between Berth 3 and Berth 8. The location of this FOPL segment is presented in Figure 2.4-1. The FOPL segment is 2,882 feet long with a 4-inch diameter. The FOPL segment is located in an area with proposed future mixed (industrial) land use (Figure 2.2-2). This FOPL segment is suspended under a concrete pier above Mare Island Strait.

This FOPL segment was previously discussed and recommended for closure in the *Draft Site Closure Summary Report for FOPL Segments G1/6/B829A&B, H1/2/B207B, I1/4/BE3BE8, and I1/4/B477 in Investigation Area C1* (CH2M HILL 2003h). Regulatory comments to this report have not been received. However, RWQCB has concluded that no further action is required at FOPL segment I1/4/BE3BE8 based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2M HILL 2002a; RWQCB 2004a).

3.19.2 Previous Actions and Investigations

A field investigation was performed along FOPL segment I1/4/BE3BE8 during 1996 and 1997, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). The entire length of this FOPL segment (2,882 feet) was successfully vacuum tested and flushed during the investigation. In addition, three soil borings were advanced adjacent to FOPL segment I1/4/BE3BE8 during previous investigations of IR14 and Building 693. IR14VB064 and IR14VB065 were advanced during 1993 during a Phase II remedial investigation of IR14 (PRC 1996b). Two soil samples were collected from each boring and analyzed for TPH-gasoline, TPH-diesel, TPH-motor-oil, and BTEX compounds. Two soil samples and one groundwater sample were also collected from B693GB011, which was advanced in 1998, immediately upgradient of FOPL segment I1/4/BE3BE8 (TtEMI 1998e). These samples were analyzed for TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX compounds.

3.19.3 2002-2003 FOPL Investigation

As concluded in the final SAP for the FOPL (CH2M HILL 2003a), additional investigation was not required at FOPL segment I1/4/BE3BE8 during the 2002-2003 field investigation.

Soil samples were not collected at 200-foot intervals (as dictated in the final SAP for previously flushed FOPL segments) along this FOPL segment because this segment is suspended under a concrete pier above Mare Island Strait. RWQCB has concluded that no further action is required at FOPL segment I1/4/BE3BE8 based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2M HILL 2002a; RWQCB 2004a).

3.19.4 Nature and Extent of Soil and Groundwater Contamination

Six soil samples and one groundwater sample have been collected along FOPL segment I1/4/BE3BE8. Soil and groundwater samples collected along this FOPL segment have not been analyzed for PAHs.

3.19.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons have been detected only at low concentrations in samples collected along FOPL segment I1/4/BE3BE8 (Figure 3.19-1). The maximum petroleum hydrocarbon concentration detected in these samples is 180 mg/kg, which was quantified as TPH-motor-oil in a soil sample collected from 8.5 feet bgs in B693GB011. In addition, BTEX compounds were not detected at concentrations exceeding reporting limits in the samples collected along this FOPL segment.

3.19.4.2 Nature and Extent of Groundwater Contamination

Petroleum hydrocarbons and BTEX compounds were not detected above analytical reporting limits in the grab groundwater sample collected from B693GB011 in 1998 (Figures 3.19-1 and 3.1-2).

3.19.5 Conclusions

FOPL segment I1/4/BE3BE8 is appropriate for permanent closure. The entire length of this FOPL segment held a vacuum during testing performed in 1996 and 1997. Following vacuum testing, the pipeline was rinsed and capped with concrete plugs, which eliminates the possibility of residual petroleum hydrocarbons being released to the Strait. Therefore, the source of potential surface-water contamination at FOPL segment I1/4/BE3BE8 has been remediated. The site has been adequately characterized. Analytical data from soil and groundwater samples collected in the vicinity of the segment indicate that a release has not occurred from FOPL segment I1/4/BE3BE8 and that an impact to groundwater has not likely occurred at this site. This segment is not a threat to groundwater or surface water and presents no significant risk to human health or to the environment. The segment is a low-risk fuel site and is appropriate for permanent closure. This recommendation is consistent with the RWQCB conclusion that no further action is required at FOPL segment I1/4/BE3BE8 based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2M HILL 2002a; RWQCB 2004a).

3.20 FOPL Segment I1/4/B477

3.20.1 Site Description

FOPL segment I1/4/B477 has a 4-inch diameter and is located in the northeast portion of IA C1. The segment extends 180 feet from Building 477 to FOPL segment I1/4/BE3BE8 at Berth 3 (Figure 2.4-1). The FOPL transported fuel to support steam-cleaning operations in Building 477, which was constructed in 1989. The FOPL segment is located in an area with proposed future mixed (industrial) land use (Figure 2.2-2). This FOPL segment was previously discussed and recommended for closure in the *Draft Site Closure Summary Report for FOPL Segments G1/6/B829A&B, H1/2/B207B, I1/4/BE3BE8, and I1/4/B477 in Investigation Area C1* (CH2M HILL 2003h). Regulatory comments to this report have not been received; however, RWQCB has concluded that no further action is required at FOPL segment I1/4/B477 based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2M HILL 2002a; RWQCB 2004a).

FOPL segment I1/4/B477 is located in soil material composed of fill material. The depth of this FOPL segment is unknown. The depth to groundwater in the vicinity of this segment is approximately 6 to 8 feet bgs. Groundwater flows to the northeast towards Mare Island Strait (Figure 2.5-1).

3.20.2 Previous Actions and Investigations

A field investigation was performed along FOPL segment I1/4/B477 during 1996 and 1997, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). During the investigation, 155 feet of this segment were removed. Additionally, a 15-foot section of the segment running beneath the railroad tracks east of Building 785 was flushed, and a 10-foot section north of Building 477 was abandoned in place.

Soil borings have been advanced in the vicinity of FOPL segment I1/4/B477 during previous investigations associated with IR03 and IR14. Four soil samples were collected from B693GB009 and B693GB016 during a field investigation of IR03 in 1998 and 1999 (TtEMI 1998e). These samples were analyzed for TPH-diesel, TPH-motor-oil, and BTEX compounds. Three soil samples collected from IR14GB0103 as part of the investigation of IR14 in 2002 were also analyzed for TPH-diesel, TPH-motor-oil, and BTEX compounds (CH2M HILL 2002f). A groundwater sample collected from IR14GB0103 was analyzed for petroleum hydrocarbons, BTEX compounds, and PAHs.

One monitoring well (03W19) is located adjacent to FOPL segment I1/4/B477. This well was installed in 1987 as part of the verification study at IR03 (Richesin/SCS 1987). Groundwater from this well is sampled routinely during quarterly monitoring events.

3.20.3 2002-2003 FOPL Investigation

As concluded in the final SAP for the FOPL (CH2M HILL 2003a), additional investigation was not required at FOPL segment I1/4/B477 during the 2002-2003 field investigation. RWQCB has concluded that no further action is required at FOPL segment I1/4/B477 based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2M HILL 2002f; RWQCB 2004a).

3.20.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon and BTEX contamination in soil and groundwater in the vicinity of FOPL segment I1/4/B477 were defined by sampling efforts performed during previous investigations of IR03 and IR14. Seven soil and one grab groundwater sample have been collected along this 180-foot segment.

3.20.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons have been detected at low concentrations in soil samples collected along FOPL segment I1/4/B477. TPH-diesel and TPH-motor-oil have been detected at maximum concentrations of 360 mg/kg (at IR14GB0103 at 5.5 feet bgs) and 240 mg/kg (at B693GB016 at 9 feet bgs), respectively (Figure 3.19-1). These results suggest that previous use of FOPL segment I1/4/B477 did not result in a significant release of petroleum hydrocarbons to the subsurface. BTEX compounds were not detected in soil samples collected along this FOPL segment (Figure 3.1-2). Soil samples collected along FOPL segment I1/4/B477 were not analyzed for PAHs.

3.20.4.2 Nature and Extent of Groundwater Contamination

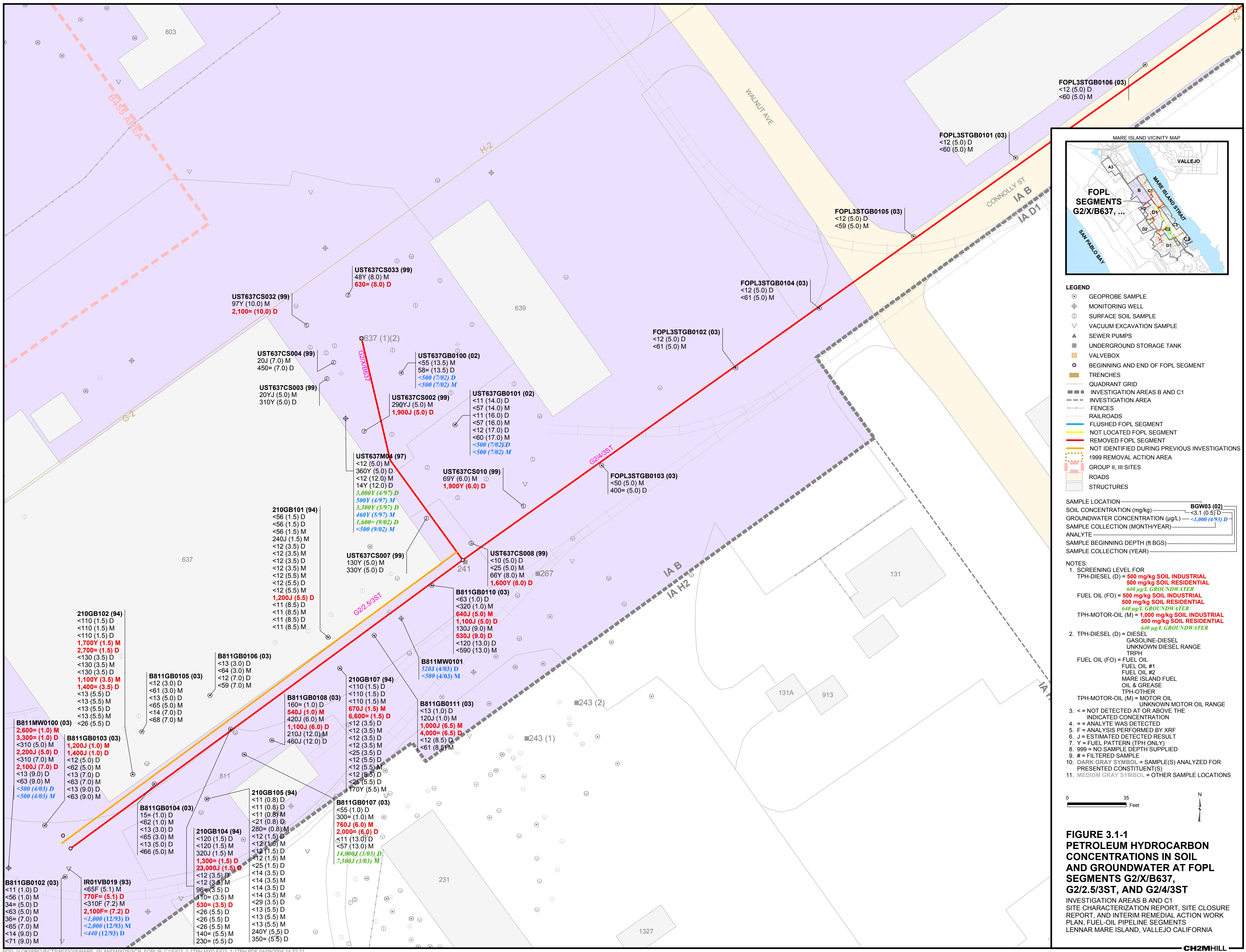
TPH-diesel and TPH-motor-oil have not been detected in groundwater collected from 03W19 during quarterly monitoring events performed during 1999, 2002, and 2003. The groundwater sample collected from IR14GB0103 in 2002 contained TPH-diesel and TPH-motor-oil at concentrations of 2,000 µg/L and 540 µg/L, respectively (Figure 3.19-1). The concentration of TPH-diesel exceeds the Tier 1 ESL for groundwater (640 µg/L). The only PAH to be detected at a concentration exceeding the Tier 1 ESL in this sample is benzo(a)pyrene, which was detected at a concentration of 0.31 µg/L. BTEX compounds were not detected in the groundwater sample. Contamination in groundwater sampled from IR14GB0103 can be attributed to releases from pre-treatment facility T-2 located upgradient of the FOPL at Building 985. Contamination associated with this facility will be addressed with IR14 in the remedial investigation report for IA C1 to be submitted in 2004. Elevated concentrations of TPH-diesel and TPH-motor-oil have also been detected in nearby monitoring well 03W08; contamination detected in this well is addressed with FOPL segments I1/6/B693A&B, I1/6/B473A&B, and I1/4/B471 (Section 4.10).

3.20.5 Conclusions

FOPL segment I1/4/B477 is appropriate for permanent closure. The majority of this FOPL segment passed vacuum testing or was removed. Following vacuum testing, the pipeline was flushed and capped with concrete plugs, which eliminates the possibility of residual petroleum hydrocarbons being released to the adjacent subsurface. Therefore, any source of potential soil and groundwater contamination from these segments has been removed or remediated. A small portion (10 feet) of this pipeline was abandoned in place north of Building 477.

The site has been adequately characterized. Available information suggests that no releases have occurred along this FOPL segment. Soil samples collected near the location of this former segment did not contain elevated levels of petroleum hydrocarbons or BTEX compounds. Elevated concentrations of petroleum hydrocarbons and PAHs detected in groundwater in the vicinity of this FOPL segment are attributed to other sources and are

addressed in other sections or in other documents. Based on the analytical data, this segment is not a threat to groundwater or surface water and presents no significant risk to human health or to the environment. The segment is a low-risk fuel site and is appropriate for permanent closure. This recommendation is consistent with the RWQCB conclusion that no further action is required at FOPL segment I1/4/B477, based on information provided to the *Draft Fuel-oil Pipeline Site Identification Technical Memorandum* (CH2M HILL 2002a; RWQCB 2004a).





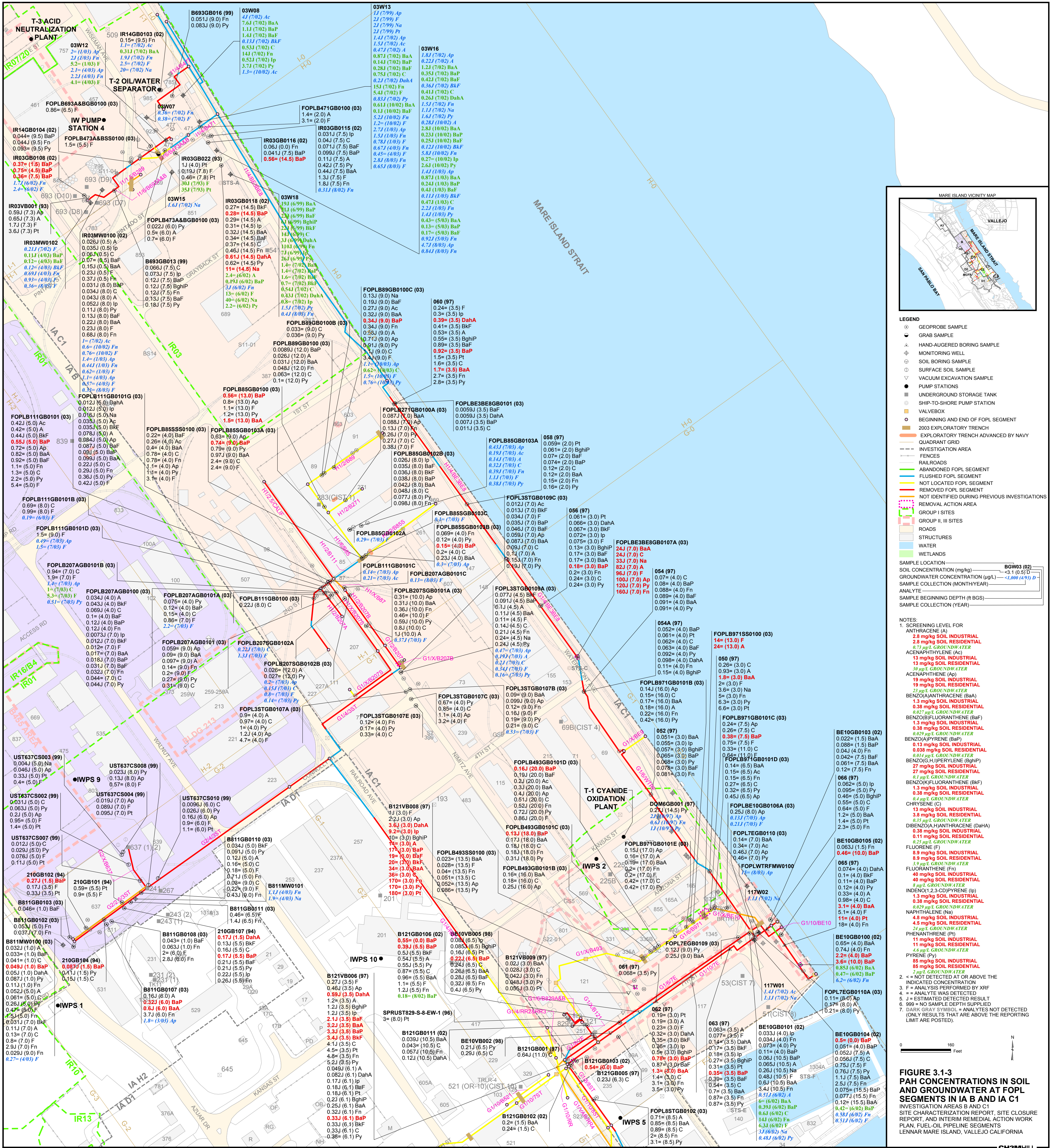


FIGURE 3.1-3
PAH CONCENTRATIONS IN SOIL AND GROUNDWATER IN IA B AND IA C1
INVESTIGATION AREAS B AND C1
SITE CHARACTERIZATION REPORT, SITE CLOSURE REPORT, AND INTERIM REMEDIAL ACTION WORK PLAN, FUEL-OIL PIPELINE SEGMENTS
LENNAR MARE ISLAND, VALLEJO, CALIFORNIA

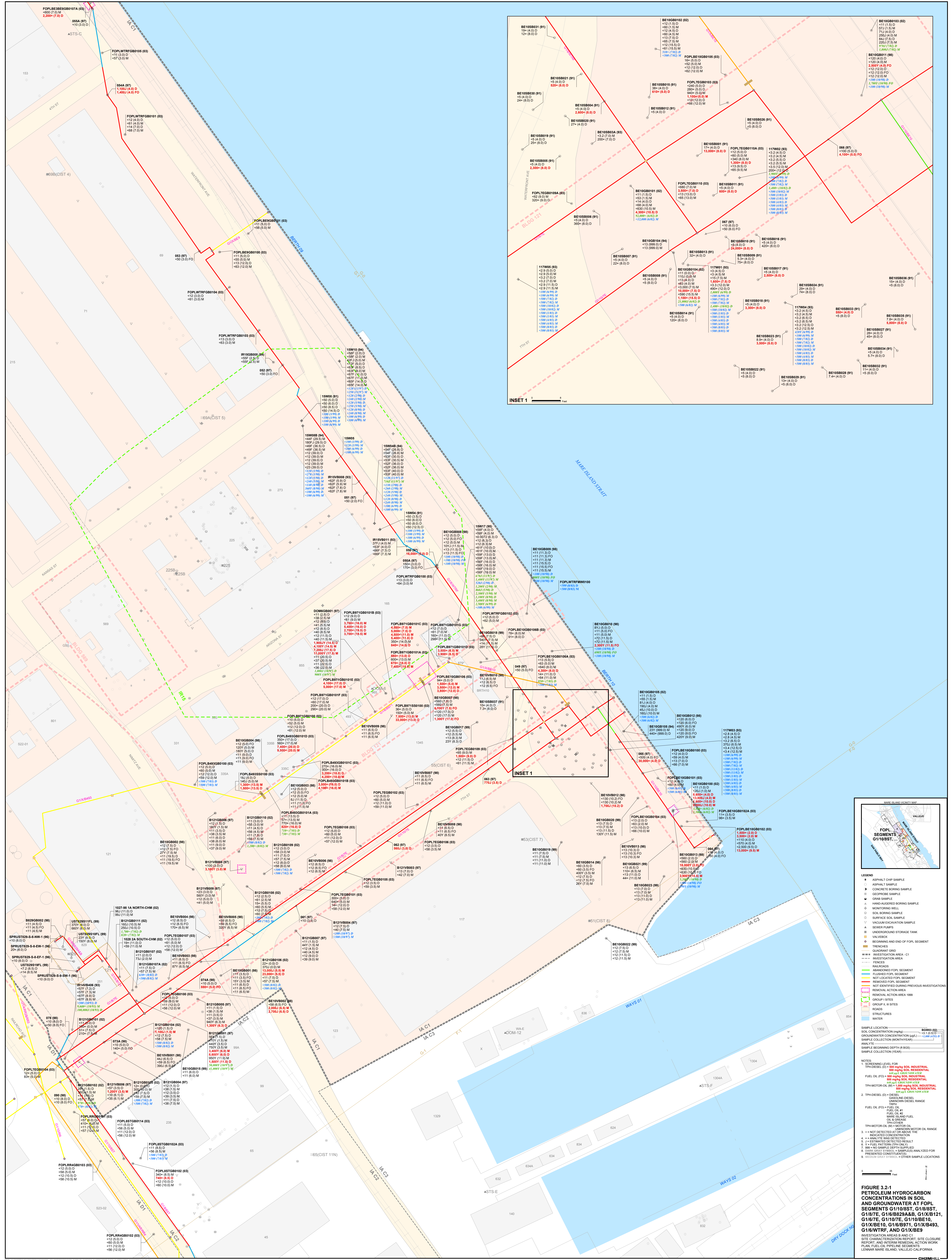


FIGURE 3.2-1
PETROLEUM HYDROCARBON
CONCENTRATIONS IN SOIL
AND GROUNDWATER AT FOPL
SEGMENTS G1/01B1, G1/01B2,
G1/01B3, G1/01B4, G1/01B5,
G1/01B6, G1/01B7, G1/01B8,
G1/01B9, G1/01B10, G1/01B11,
G1/01B12, G1/01B13, G1/01B14,
G1/01B15, G1/01B16, G1/01B17,
G1/01B18, G1/01B19, G1/01B20,
G1/01B21, G1/01B22, G1/01B23,
G1/01B24, G1/01B25, G1/01B26,
G1/01B27, G1/01B28, G1/01B29,
G1/01B30, G1/01B31, G1/01B32,
G1/01B33, G1/01B34, G1/01B35,
G1/01B36, G1/01B37, G1/01B38,
G1/01B39, G1/01B40, G1/01B41,
G1/01B42, G1/01B43, G1/01B44,
G1/01B45, G1/01B46, G1/01B47,
G1/01B48, G1/01B49, G1/01B50,
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G1/01B60, G1/01B61, G1/01B62,
G1/01B63, G1/01B64, G1/01B65,
G1/01B66, G1/01B67, G1/01B68,
G1/01B69, G1/01B70, G1/01B71,
G1/01B72, G1/01B73, G1/01B74,
G1/01B75, G1/01B76, G1/01B77,
G1/01B78, G1/01B79, G1/01B80,
G1/01B81, G1/01B82, G1/01B83,
G1/01B84, G1/01B85, G1/01B86,
G1/01B87, G1/01B88, G1/01B89,
G1/01B90, G1/01B91, G1/01B92,
G1/01B93, G1/01B94, G1/01B95,
G1/01B96, G1/01B97, G1/01B98,
G1/01B99, G1/01B100.



4.0 Characterization of FOPL Segments within IA B and IA C1 Requiring Further Investigation and/or Remedial Action

This section presents site descriptions, summaries of previous investigations, summaries of the 2002-2003 FOPL investigation, an evaluation of the nature and extent of contamination, and a proposal for further investigative and/or remedial action at two FOPL segments within IA B and 13 FOPL segments within IA C1. Investigative and/or remedial actions will be performed following discussion with regulatory agencies on the recommendations made in this report. A summary of the interim remedial actions proposed for FOPL segments in IA B and IA C1 is presented in Figure 4.1-1. The results of the proposed interim remedial actions will be documented in a future implementation report for FOPL segments in IA B and IA C1.

The following segments that require further investigation and/or remedial action are discussed in this section and listed below:

- G2/4/3ST
- G2/2.5/3ST
- G1/6/7E
- G1/10/7E
- G1/10/BE10
- G1/X/BE10
- G1/6/B971
- G1/4/BE3BE8
- G1/2/B207
- H1/6/B85
- H1/2/B89
- I1/1.5/B289
- I1/6/B693A&B
- I1/6/B473A&B
- I1/4/B471

4.1 FOPL Segments G2/4/3ST and G2/2.5/3ST

4.1.1 Site Description

FOPL segments G2/4/3ST and G2/2.5/3ST are located in IA B south of Building 637 within a concrete utility vault. The locations of these FOPL segments are presented in Figure 2.4-1. FOPL segment G2/4/3ST has a 4-inch diameter and extends from southwest corner of Building 637 beneath Connolly Street to the south side of Building 223, where it connects to segment G1/4/3ST. FOPL segment G2/4/3ST is 871 feet long. FOPL segment G2/2.5/3ST has a 2.5-inch diameter and is 284 feet long. The future land use at FOPL segments

G2/4/3ST and G2/2.5/3ST is residential (Figure 2.2-2). These FOPL segments are located in an area with a surface elevation of 20 feet above msl. The nearest surface water is the wetlands area located approximately 1,000 feet west. Regional groundwater flow in the area is primarily north to northwest. Depths to groundwater in March 2003 ranged from approximately 5 to 9 feet bgs.

FOPL segments G2/4/3ST and G2/2.5/3ST are being investigated in conjunction with the Building 811 Area, as documented in the *Site Characterization Report and Interim Remedial Action Work Plan for Building 811 Area in Investigation Area B, Lennar Mare Island, Vallejo, California* (CH2M HILL pending). Building 811 was built in 1944. The approximately 1,200-square-foot building was originally part of the locomotive maintenance facility (primarily conducted in Building 637) and was used as a railroad equipment maintenance shop. Various solvents, oils, greases, detergents, and fuels were probably used at the building during maintenance activities. Building 811 is currently not in use, and is scheduled for demolition. A vehicle wash area (including an OWS and diesel AST), a former service island, and two hydraulic hoists have been identified as additional sources of contamination in the Building 811 Area.

4.1.2 Previous Actions and Investigations

The entire 871 feet of FOPL segment G2/4/3ST was reported as previously removed from the sidewalk vault during the installation of the steam lines (Weston 2001). However, the vault was visually inspected during an investigation conducted by PRC Environmental Management, Inc. (PRC) in 1994 and reportedly contained both steam lines and FOPLs (PRC 1995a). No attempt was made to locate FOPL segment G2/2.5/3ST during previous investigations. This segment was identified during a review of historical Navy maps performed in 2002.

A previous investigation was conducted in 1994 in the area south of Building 637 to evaluate potential contamination at the site (PRC 1995a). During the 1994 investigation, 25 soil samples were collected from seven borings (210GB101- 210GB0107) around the Building 811 Area (PRC 1995a). The samples were collected to evaluate potential sources of contamination, including FOPL segments G2/4/3ST and G2/2.5/3ST. Borings 210GB101, 210GB102, 210GB104, and 210GB107 were advanced along these FOPL segments. Samples were analyzed for TPH, VOCs, SVOCs, metals, and PCBs. The concrete utility vault on the south side of Building 637 was visually inspected and found to contain steam lines, an air line, and two possible FOPLs. The vault contained standing water, which had an oily sheen but no noticeable odor. Based on the 1994 investigation results, this area was identified as a potential source of contamination in the preliminary assessment/site investigation performed by PRC in 1995 (PRC 1995b).

Soil and groundwater samples were collected at the Building 811 Area in March 2003 in accordance with the *Draft Site Investigation Work Plan for the B811 Area* (CH2M HILL 2002c). The purpose of the investigation was to evaluate the nature and extent of petroleum hydrocarbon contamination in soil and groundwater associated with the four source areas identified within the Building 811 Area (Section 4.1.1). Twelve direct-push borings (B811GB0100 through B811GB0111) and two monitoring wells (B811MW0100 and B811MW0101) were advanced. One existing monitoring well (UST243/231MW0102) was re-sampled. Of these sampling locations, B811GB0103, B811GB0104, B811GB0110,

B811GB0111, and B811MW0101 were advanced along FOPL segments G2/4/3ST and G2/2.5/3ST (CH2M HILL pending).

4.1.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment G2/4/3ST were required following the previous investigations. Six borings (FOPL3STGB0101 through FOPL3STGB0106) were advanced along this segment in June 2003 to satisfy the requirement that samples be collected at 50-foot intervals in residential areas and at 100-foot intervals in industrial areas. Soil samples were collected from each boring at approximately 5 feet bgs. The suspected depth of this pipeline is approximately 3 feet bgs. No unusual odors or other indication of contamination was noted during drilling of these borings.

The top of the utility corridor in which the FOPL segments are suspected of being located was temporarily removed at the southeast corner of Building 637 to determine if the FOPL segments are present in the corridor. Two pipelines suspected of being the FOPL were identified in the corridor, suggesting that FOPL segment G2/4/3ST was not previously removed as reported. The pipelines were approximately 2.5 and 4 inches in diameter. Further action will be taken to confirm that these utilities are FOPL, and to subsequently drain these pipelines once this confirmation is made (Section 4.1.5).

4.1.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of soil and groundwater contamination have been defined by analytical data from samples collected during previous investigations as well as the 2002-2003 FOPL investigation. Fifty soil and three groundwater samples have been collected along FOPL segments G2/4/3ST and G2/2.5/3ST.

4.1.4.1 Nature and Extent of Soil Contamination

Analytical data for samples collected along FOPL segments G2/4/3ST and G2/2.5/3ST are presented in Figure 3.1-1. In the immediate vicinity of FOPL segments G2/4/3ST and G2/2.5/3ST, TPH-diesel was detected at concentrations up to 23,000 mg/kg (at 1.5 feet bgs at 210GB104), and TPH-motor-oil was detected at concentrations up to 1,700 mg/kg (at 1.5 feet bgs at 210GB102) prior to the 2003 investigation of the Building 811 Area. Elevated concentrations at 210GB104 and 210GB102 are vertically delineated by samples collected at a greater depth (5.5 feet bgs). Elevated concentrations of petroleum hydrocarbons were also detected in samples collected from IR01VB019, 210GB107, 210GB101, and UST637CS008. The vertical extent of elevated concentrations of petroleum hydrocarbons in samples collected from 210GB101 and 210GB107 is defined by data collected from greater depths (3.5 to 8.5 feet bgs). A confirmation sample collected from UST637CS008 at 8 feet bgs following excavation of USTs 637-1 and 637-2 contained TPH-diesel at a concentration of 1,600 mg/kg; the vertical extent of contamination in this sample not defined. The soil sample collected from IR01VB019 at 7.2 feet bgs contained TPH-diesel at a concentration of 2,100 mg/kg; the vertical extent of contamination in this sample also not defined. The lateral extent of contamination associated with the FOPL segments is generally not defined, as the contamination appears to co-mingle with

contaminated soil from other sources. Consequently, contaminated soil from various sources in the Building 811 Area is being evaluated together in the *Draft Site Characterization Report and Interim Remedial Action Work Plan for Building 811 Area in Investigation Area B* (CH2M HILL pending).

During the 2003 investigation TPH-diesel and TPH-motor-oil were detected at concentrations greater than the Tier 1 ESL for residential sites (500 mg/kg) in the following locations:

- West of FOPL segments G2/4/3ST and G2/2.5/3ST – B811GB0103 and B811MW0100 (up to 3,300 mg/kg at 1 foot bgs).
- South of FOPL segments G2/4/3ST and G2/2.5/3ST, north of Building 811 – B811GB0107 and B811GB0108 (up to 2,000 mg/kg at 6 feet bgs).
- Along FOPL segments G2/4/3ST and G2/2.5/3ST near the southeast corner of Building 637 – B811GB0110 and B811GB0111 (up to 4,000 mg/kg at 6.5 feet bgs).

Contamination is vertically delineated at each of the locations advanced in the vicinity of FOPL segments G2/4/3ST and G2/2.5/3ST during 2003. Concentrations of petroleum hydrocarbons above Tier 1 ESLs were detected in samples collected as deep as 9 feet bgs (Figure 3.1-1). Contamination associated with FOPL segment G2/4/3ST appears to be limited to the Building 811 Area; TPH-diesel and TPH-motor-oil were generally not detected in samples collected in 2003 from locations east of Building 637. One sample collected from FOPL3STGB0103, which is south of Building 639, contained TPH-diesel at a concentration of 400 mg/kg (Figure 3.1-1). This concentration is below the Tier 1 ESL.

Benzo(a)pyrene is the only PAH that has been detected in soil in the vicinity of FOPL segments G2/4/3ST and G2/2.5/3ST at concentrations greater than the Tier 1 ESL (0.038 mg/kg) (Figure 3.1-3). Of the 12 soil samples collected along FOPL segment G2/4/3ST and G2/2.5/3ST that were submitted for analysis of PAHs, only one sample contained benzo(a)pyrene at concentrations exceeding the Tier 1 ESL. Benzo(a)pyrene was detected at a concentration of 0.049 mg/kg at 1 foot bgs in B811MW0100.

4.1.4.2 Nature and Extent of Groundwater Contamination

The only sample found to contain constituents at concentrations exceeding Tier 1 ESLs is the grab groundwater sample collected from B811GB0107 in 2003. TPH-gasoline, TPH-diesel, TPH-motor-oil, and xylene were detected at concentrations of 4,900 µg/L, 14,000 µg/L, 7,500 µg/L, and 18 µg/L, respectively, in this sample. The corresponding Tier 1 ESLs for these analytes are 500 µg/L, 640 µg/L, 640 µg/L, and 13 µg/L, respectively (Table 1.4-1). This contamination appears to be localized, as petroleum hydrocarbons were not detected in groundwater samples collected during 2003 in monitoring wells B811MW0100 and B811MW0101. Based on groundwater elevation data presented in Figure 2.5-1, B811MW0101 is located downgradient of B811GB0107.

4.1.5 Conclusions and Recommendations for Further Investigative and/or Remedial Action

Elevated concentrations of petroleum hydrocarbons, PAHs, and BTEX compounds have been detected in soil and groundwater samples collected along FOPL segments G2/4/3ST

and G2/2.5/3ST in the area south of Building 637 (the Building 811 Area). Results of the 2003 investigation of the Building 811 Area indicate that TPH-diesel, TPH-motor-oil, and benzo(a)pyrene are present in soil at concentrations exceeding Tier 1 ESLs, and TPH-gasoline, TPH-diesel, TPH-motor-oil, and xylene are present in groundwater at concentrations exceeding the Tier 1 ESLs in samples collected near the FOPL. FOPL segments G2/4/3ST and G2/2.5/3ST are considered source areas of concern at the Building 811 Area, along with a former vehicle wash area, a former service island, and two hydraulic hoists. Contamination that is present as a result of releases from these various source areas may pose a risk to future residents and ecological receptors. Due to co-mingling of contamination from these sources, excavation of soil will be performed to address contamination at the Building 811 Area as a whole. *Draft Site Characterization Report and Interim Remedial Action Work Plan for Building 811 Area in Investigation Area B, Lennar Mare Island, Vallejo, California* (CH2M HILL pending) presents the remedial action proposed for this area. As presented in this document, the pipelines suspected of being the FOPL and the concrete vault in which the pipelines are located will be removed during the remedial action. If the pipelines are confirmed to be FOPL, the pipeline contents will be drained prior to removal. Contaminated soil along the utility corridor will be removed to approximately 4 to 7 feet bgs for a total soil excavation volume of approximately 280 cubic yards (CH2M HILL pending). This remedial action will support eventual regulatory closure of FOPL segments G2/4/3ST and G2/2.5/3ST in accordance with the RWQCB Order.

4.2 FOPL Segments G1/6/7E, G1/10/7E, and G1/10/BE10

4.2.1 Site Description

FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E are located within the boundaries of the Building 121 and Berth 10 Areas in IA C1. The area investigated is located north and west of Building 117, east of Berth 10, and southwest to southeast of Building 121 (Figure 2.4-1). FOPL segments G1/10/7E and G1/6/7E are 10 and 6 inches in diameter, respectively, and are portions of pipeline that extend from a valve box at Berth 10 to the valve box beneath the intersection of Railroad Avenue and 7th Street. FOPL segment G1/6/7E is located directly above FOPL segment G1/10/7E over most of the length of these FOPL segments. FOPL segment G1/10/BE10 has a 10-inch diameter and extends along Berth 10 in a north-northwestern direction (Figure 2.4-1). FOPL segments G1/10/7E, G1/6/7E, and G1/10/BE10 are 882 feet, 1,000 feet, and 211 feet long, respectively. The FOPL segments were buried at approximately 3 to 5 feet bgs. The FOPL segments are part of a network of piping that historically transported fuel oil from ships at Berth 10 to the 2.1-million-gallon UST 772 (IR23). UST 772 served as an auxiliary storage of fuel oil required to operate the central steam power plant (Building 121) in the event the primary supply of gas was interrupted (PRC 1991).

The topography of the Building 121 and Berth 10 Areas is generally flat, with elevations between 8 to 18 feet above msl, sloping toward the Strait. The ground surface in the Berth 10 and Building 121 Areas is paved with asphalt and/or concrete. The area has a proposed mixed (industrial) land use (Figure 2.2-2). Therefore, no upland habitat will develop in the future. The depth to groundwater in the Berth 10 and Building 121 Areas ranges from between 6.5 and 10 feet bgs. Most of the monitoring wells in the Berth 10 Area are located

within 100 feet of the Strait. Groundwater levels greater than 50 feet from the Strait are not expected to be tidally influenced. Groundwater flows primarily to the north-northeast (Figure 2.5-1). Groundwater levels and gradients appear to be influenced by variations in fill material lithology and by other man-made subsurface structures.

The majority of the Berth 10 and Building 121 Areas is within the 1859 boundary of Mare Island. Fill is found from 1 to over 15 feet bgs and consists of a wide variety of materials, from clay with sand and gravel to coarse gravel with wood and brick fragments. The fill is generally thickest closest to the Strait, but is absent in some areas, mainly in the vicinity of Building 121. The fill associated with utility and other pipeline corridors was mainly sand and gravel and was encountered between 2 and 7 feet bgs. The unconsolidated natural deposits are found from ground surface to over 20 feet bgs. This unit thickens eastward in the direction of Mare Island Strait and is underlain by the Cretaceous Panoche Formation bedrock. Bedrock (weathered claystone, siltstone, and sandstone) is observed from 2 to 15 feet bgs over most of the site but is deeper than 20 feet bgs closest to Mare Island Strait.

4.2.2 Previous Actions and Investigations

The network of FOPL that extends from former UST 772 to Berth 10 (including FOPL segments G1/10/BE10 and G1/6/7E) was tested for leaks during the week of June 3, 1991. Approximately 30,000 gallons of fuel spiked with a tracer compound were pumped through the FOPL from UST 772 to identify points of fracture in the pipeline and in the UST. As a result of this tightness test, fuel oil was released to the environment at locations where the integrity of the FOPL had been compromised. One of several suspected leaks was detected near a valve box located at the intersection of FOPL segments G1/6/7E and G1/6/WTRF (Figure 2.4-1). An unknown quantity of contaminated soil was excavated at this location, and a hole in the FOPL was identified approximately 8 feet west of the valve box. Approximately 18,000 gallons of fuel were spilled during the test. Fuel oil was observed floating on Mare Island Strait during the test. Mare Island and United States Coast Guard emergency response teams contained the product with floating booms and absorbent material. In addition, the point of release at the valve box is adjacent to a sanitary sewer line. A video camera survey performed in the sanitary sewer line following the leak test clearly showed diesel fuel entering the sanitary sewer line (at joints and cracks) near this location. Floating product was also observed in sanitary sewer pump stations No. 4 and No. 6 as a result of this release (PRC 1991).

Immediately after the fuel was pumped through the pipeline, a soil gas survey was performed adjacent to the pipeline to search for the tracer compound and identify additional areas of pipeline leakage. Probes with detection radii of approximately 10 to 12 feet were driven into the ground along the FOPL at approximately 20-foot intervals (PRC 1991). Based on analysis of the soil gas samples, fuel leaks greater than 0.05 gallon per hour were detected at two sample locations positioned along FOPL segment G1/6/7E and within 200 feet west of the valve box located at the intersection of FOPL segments G1/6/7E and G1/6/WTRF. These previous leak locations are near monitoring well 117W05 and boring FOPL7EGB0102 (Figure 3.2-1).

Forty-three soil borings were drilled or probed in the vicinity of the suspected pipeline leak locations during two separate sampling events performed between 1991 and 1993 to assess the extent of contamination in soil and groundwater associated with the June 1991 fuel spill.

Seventy-three soil samples were collected and analyzed during these investigations. Five of the borings were converted to groundwater monitoring wells (117W01 through 117W05), and three rounds of groundwater samples were subsequently collected (April 1993, June 1993, and June 1999). Soil samples were analyzed for TPH-motor-oil and/or TPH-diesel. Sixteen samples from six soil borings were analyzed for BTEX during the second sampling event (PRC 1995c). The analytical data from these investigations indicated that fuel oil released during tightness testing in 1991 had migrated through the subsurface at the interface with the water table rather than through the vadose zone.

The 1993 investigation also included a tidal influence study in the groundwater monitoring wells and slug testing to measure hydraulic conductivity (PRC 1996a). The tidal influence study found that the wells in the vicinity of the valve box were subject to tidal fluctuation. During the study period, the maximum tidal fluctuations in Mare Island Strait were 8.5 feet, while the maximum tidal fluctuations in the wells varied from 0.43 foot in well 117W05 to 2.7 feet in well 117W03 (located closest to the Mare Island Strait).

Additional samples were collected in the vicinity of Building 121 (and FOPL segments G1/6/7E and G1/10/7E) in 1997 for the preliminary assessment, site investigation, and remedial investigation of the Group II/III Sites at Mare Island (including the Building 121 Area) (TiEMI 2001b). Activities relevant to the FOPL included the advancement of four soil borings (B121GB001, B121GB004, B121GB005, and B121GB007) and five vacuum excavation holes (B121VB003, B121VB004, B121VB006, B121VB008, and B121VB009), as well as the collection of two groundwater samples. Soil and groundwater samples were analyzed for TPH, BTEX, and PAHs.

As part of the island-wide FOPL removal/abandonment program, the following tasks associated with FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E were performed during 1997, as documented in *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001):

- FOPL segments G1/10/BE10, G1/6/7E, and G1/6/BE10 were removed, with exception of 60 feet of FOPL segment G1/10/BE10 located beneath crane tracks that were abandoned in place and 110 feet of FOPL segment G1/10/7E located beneath Nimitz Avenue that were flushed and left in place (Figure 2.4-1). FOPL segment G1/6/7E was found inside FOPL segment G1/10/7E under Nimitz Avenue but ran on top of FOPL segment G1/10/7E for the remaining portions of these FOPL segments.
- Approximately 5 cubic yards of ABM were removed along the entire length of FOPL segment G1/10/BE10, 3 cubic yards of ABM were removed along the entire length of pipeline beneath the railroad tracks along FOPL segment G1/10/7E, and 10 cubic yards of ABM were removed along the entire length of FOPL segment G1/6/7E.
- During the removal activities of FOPL segment G1/6/7E, an old brick manifold containing residual fuel oil was encountered. This structure is suspected of being unknown Cistern No. 6 (UST 55). A request for closure of this cistern was made in June 2002 (CH2M HILL 2002d).
- The valve box located at the southern end of FOPL segment G1/10/BE10 was removed along with all associated piping and valves. The valve box located at the northern end of

FOPL segment G1/10/BE10 could not be removed due to the proximity to crane tracks. The valve box was filled with concrete.

- Thirteen soil samples (064, 065, 066, 067, 063, 062, 061, 074, 074A, 073, 073A, 078, and 121) were collected at 11 locations along the removed portion of the FOPL segments from 3 to 7 feet bgs. Due to the presence of contamination in samples 074 and 073, soil at these locations was over-excavated. Additional soil samples (074A and 073A) were collected following overexcavation.

In 1998 and 1999, an investigation was conducted to assess the extent of contamination associated with portions of the FOPL that were removed during 1997 and to evaluate the extent of impacts to groundwater that resulted from the 1991 spill. An attempt was made to advance 23 borings (borings BE10GB006 and BE10GB016 met refusal near the ground surface and were not logged) and 13 vacuum excavation holes to further characterize contamination associated with historical releases from the FOPL in the Berth 10 Area. All soil samples were analyzed for TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX. Grab groundwater samples were collected from five of the borings in October 1998. The abundance of utility piping at this location provided multiple migration pathways, resulting in a widespread distribution of the released fuel (TtEMI 2001c).

Soil and groundwater samples were collected from 14 borings (BE10GB0100 through BE10GB0105, B121GB0101 through B121GB0104, B121GB0106, B121GB0108 through B121GB0110) during an investigation to complete the characterization of contamination in the Berth 10 Area during 2002. Soil samples were collected from 0 to 10.5 feet bgs. Groundwater samples were collected at the water table. Soil and groundwater samples were generally analyzed for TPH-diesel, TPH-motor-oil, and PAHs to improve the understanding of the conceptual site model and to support the human health and ecological risk assessments. The field activities were performed consistent with the *Draft Sampling and Analysis Plan for Investigation Area C1* (CH2M HILL 2002f). Additionally, groundwater samples were collected from five monitoring wells (117W01 through 117W05) and analyzed for TPH-diesel, TPH-motor oil, PAH, BTEX and natural attenuation parameters during quarterly monitoring events performed between July 2002 through August 2003.

4.2.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E were required following the previous investigation. Soil samples associated with FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E were collected from 17 borings (FOPL7EGB0100, FOPL7EGB0101, FOPL7EGB0102, FOPL7EGB0103, FOPL7EGB0104, FOPL7EGB0105, FOPL7EGB0106, FOPL7EGB0107, FOPL7EGB0108, FOPL7EGB0109, FOPL7EGB0109A, FOPL7EGB0110, FOPL7EGB0110A, FOPLBE10GB0100, FOPLBE10GB0101, FOPLBE10GB0102, and FOPLBE10GB0102A) from 3.5 to 13.5 feet bgs, and groundwater was collected from one boring (FOPLBE10GB0101) using a temporary PVC well. Refusal was encountered at several original boring locations due to concrete, asphalt, or other hard material at depth. Sample locations FOPL7EGB0102, FOPL7EGB0104, and FOPL7EGB0107 had to be relocated one or more times due to refusal. A red brick obstruction was encountered at 3 feet bgs, and a void was encountered from 4 to 15 feet bgs at the original location of FOPL7EGB0102. Based on previous documentation of

the lateral extent of Cistern No. 6 (UST 55), it was concluded that this cistern was struck during drilling and FOPL7EGB0102 was subsequently relocated a few feet to the west.

Table 4.2-1 presents a summary of the significant observations made during drilling of borings at FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E in 2003.

TABLE 4.2-1

Significant Observations Made During Drilling at FOPL Segments G1/10/7E, G1/10/BE10, and G1/6/7E in 2003
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

Location	Depth of Staining and/or Odor	Maximum PID reading and depth
FOPLBE10GB0102	7 to 10.5 feet bgs	59 ppm at 2.5 feet bgs
FOPL7EGB0109	8.5 to 10.5 feet bgs	6.5 ppm at 8.5 feet bgs
FOPL7EGB0109A	7.5 to 10 feet bgs	45 ppm at 10 feet bgs
FOPL7EGB0103	8 feet bgs	--
FOPL7EGB0110	7 to 10 feet bgs	48.9 ppm at 7 feet bgs
FOPL7EGB0110A	8 feet bgs	41.1 at 8 feet bgs

Note:

-- No VOCs detected with PID.

4.2.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of TPH, BTEX, and PAH contamination in the vicinity of FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E were defined by sampling efforts performed during previous investigations of the FOPL and the Berth 10 Area. Soil and groundwater sample locations and results are presented in Figure 3.2-1. Two hundred nine soil samples and 50 groundwater samples have been collected along these FOPL segments (including groundwater samples collected from groundwater monitoring wells since 1999 only).

4.2.4.1 Nature and Extent of Soil Contamination

Medium- to heavy-end petroleum hydrocarbons (TPH-diesel, TPH-motor oil, and TPH-fuel-oil) were detected at elevated concentrations in samples collected near FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E between 1991 and 2003. Figure 3.2-1 presents the distribution of the TPH compound sample results. Elevated concentrations of petroleum hydrocarbons were predominantly detected in soil samples collected in the vicinity of the leak at the intersection of FOPL segments G1/6/7E and G1/6/WTRF. TPH-gasoline was only detected in one of 16 soil samples at a concentration of 2 mg/kg (B121GB005 at 6.5 feet bgs). TPH-diesel was detected at concentrations exceeding analytical reporting limits in 71 of 209 soil samples. Twenty-seven samples contained TPH-diesel at concentrations exceeding the Tier 1 ESL (500 mg/kg). The elevated TPH-diesel concentrations were detected in soil samples collected between 3 and 15.5 feet bgs. The maximum concentration of TPH-diesel detected in these samples was approximately 30,000 mg/kg, which was detected in sample 065 (collected in 1997 along FOPL segment G1/10/BE10 at 4 feet bgs). The TPH-diesel contamination is bounded by 138 nondetect sample locations collected from between 1 and 16 feet bgs.

Of 170 sample locations, 54 soil samples contained TPH-motor-oil or TPH-fuel-oil at concentrations exceeding analytical reporting limits. Only 15 sample locations contained TPH-motor-oil and TPH-fuel-oil at elevated concentrations (i.e., above Tier 1 ESLs). Elevated concentrations of these constituents were generally detected in samples collected near FOPL segment G1/10/BE10 and between Building 121 and FOPL segment G1/10/7E. TPH-fuel-oil and TPH-motor-oil were detected at maximum concentrations of 18,000 mg/kg (at BE10GB013) and 13,000 mg/kg (at BE10GB0100 and FOPLBE10GB0102), respectively. TPH-motor-oil contamination is bounded by almost 94 nondetect sample locations between 1 and 20 feet bgs.

BTEX compounds were not detected at concentrations exceeding Tier 1 ESLs in soil samples associated with FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E (Figure 3.1-2). Benzene was only detected in one soil sample; ethylbenzene was detected in three soil samples; toluene was detected in 18 soil samples; and xylenes were detected in six soil samples out of a total of 78 soil samples for which BTEX compounds were analyzed.

Some PAH compounds were detected at concentrations exceeding Tier 1 ESLs in at least one sample associated with FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E. These PAHs include anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, pyrene, ideno(1,2,3-cd)pyrene, chrysene, fluoranthene, dibenz(a,h)anthracene, and phenanthrene. Analytical data for samples containing PAHs at concentrations exceeding analytical reporting limits are presented in Figure 3.1-3. Elevated concentrations of PAHs were detected in 14 samples collected in the vicinity of FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E. The greatest concentrations of PAHs were detected in a soil sample collected from 3 feet bgs at B121VB008, which is located north of FOPL segment G1/6/7E. These areas of elevated contamination are bounded by no less than 51 nondetect sample locations, with samples up to 16 feet bgs.

The PAH and TPH compounds identified as being present in soil at elevated concentrations were quantified in the Tier 2 risk analysis, outlined in Appendix D, to determine whether each chemical causes significant human health or ecological risk. Tier 2 screening levels were developed in accordance with RWQCB guidance (RWQCB 2003) and based on site-specific conditions. The Tier 2 screening levels for these analytes in soil and associated EPCs are presented in Table 1.4-3. With exception to benzo(a)pyrene, the EPCs for all PAH and TPH compounds are below Tier 2 screening levels. The EPC is intended to represent an upper-bound average concentration that receptors would be exposed to at the site and is either the 95th percentile upper confidence limit (95 percent UCL) on the mean or the maximum observed concentration. Benzo(a)pyrene was detected at concentrations exceeding the Tier 2 screening level (1.3 mg/kg) in samples collected from between 3 and 10 feet bgs at BE10GB0100, B121VB006, and B121VB008. Soil with elevated concentrations of benzo(a)pyrene will require remedial action at the site, as discussed further in Section 4.2.5.

4.2.4.2 Nature and Extent of Groundwater Contamination

Groundwater data used for this analysis includes all grab-groundwater samples but includes only recent monitoring well data (collected from 1999 to more recent). Data collected since January 1999 most accurately reflect recent site conditions.

Medium- to heavy-end petroleum hydrocarbons (TPH-diesel and TPH-motor-oil) have been detected at elevated concentrations in groundwater samples collected near FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E. Figure 3.2-1 shows the distribution of the TPH compound sample results. TPH-gasoline was only detected in one of seven groundwater samples at a concentration of 380 µg/L (at monitoring well 117W05 in 1999). The analytical results for more recent groundwater samples collected from this location have been nondetect for TPH-gasoline. TPH-diesel was detected in 12 of 50 groundwater samples. Eleven samples contained TPH-diesel at concentrations greater than the Tier 1 ESL (640 µg/L). TPH-motor-oil was detected in six of 50 groundwater samples. Four samples contained TPH-motor-oil at concentrations greater than 640 µg/L. The maximum detected TPH-diesel and TPH-motor-oil concentrations were detected in grab samples collected in 2002. The maximum concentrations are 92,000 µg/L for TPH-diesel (at BE10GB0101) and 1,800 µg/L for TPH-motor-oil (at BE10GB0103). Most of elevated concentrations were detected in samples collected at and downgradient of the location of the 1991 fuel release.

As expected, TPH-diesel and TPH-motor-oil in groundwater appear to be attenuating with time. Concentrations of TPH-diesel and TPH-motor-oil have declined in monitoring wells in the Berth 10 Area (117W01 through 117W05) and have been nondetect since January 2003 (based on quarterly sampling results). These results are most representative of the existing groundwater conditions in the Berth 10 Area. These monitoring wells are positioned at and downgradient of the source of contamination. Elevated petroleum hydrocarbons concentrations observed near the Strait in grab samples collected in 2002 are likely not representative of site conditions.

Fourteen groundwater samples were analyzed for BTEX compounds. Ethylbenzene was the only BTEX compound detected in groundwater. It was detected at a low concentration (0.4 µg/L) in a groundwater grab sample (BE10GB013) in the Berth 10 Area (Figure 3.1-2). This is below the Tier 1 ESL.

Some PAH compounds were detected at elevated concentrations in at least one sample associated with FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E. These PAHs include benzo(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, and fluorene. PAH compounds were detected at elevated concentrations in grab groundwater samples collected during 2002 (BE10GB0100, BE10GB0101, BE10GB0104, and B121GB0106) adjacent to FOPL segment G1/10/BE10 (near the Strait) (Figure 3.1-3). Benzo(a)anthracene was detected in two of 36 groundwater samples with concentrations of 0.85 µg/L and 6 µg/L. Benzo(a)pyrene was detected in 4 of 36 groundwater samples at concentrations between 0.18 µg/L and 0.47 µg/L. Chrysene, fluoranthene, and fluorene were each detected at elevated concentrations in one groundwater sample. The areas of elevated concentrations are bound by no less than 32 sample locations with nondetect results for these PAHs. PAHs have generally not been detected in groundwater collected from monitoring wells 117W01 through 117W05 during recent groundwater monitoring events. Naphthalene was detected at a low concentration (1.1 µg/L) in groundwater samples collected from 117W01 and 117W02 during July 2002.

TPH-diesel, TPH-motor-oil, benzo(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, and fluorene were detected at concentrations exceeding Tier 1 ESLs and were consequently included in a Tier 2 risk analysis. The methodology used in the Tier 2 risk analysis is

presented in Appendix D. Tier 2 screening levels were developed in accordance with RWQCB guidance (RWQCB 2003) and based on site-specific conditions. The COPCs in groundwater were detected at concentrations significantly below the Tier 2 screening level of 50,000 µg/L (Table 1.4-4).

4.2.5 Conclusions and Recommendations for Further Investigative and Remedial Action

The entire length of the FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E have either been removed, flushed, or abandoned in place. Following vacuum testing, the pipeline was rinsed and capped with concrete plugs, which eliminates the possibility of residual petroleum hydrocarbons being released to the Strait. The length of abandoned pipe was filled with concrete, which eliminates the possibility of residual petroleum hydrocarbons being released to the adjacent subsurface. Therefore, any source of potential soil and groundwater contamination from these segments has been removed or remediated.

The site has been adequately characterized. Soil and groundwater samples have been collected from 106 boring locations, and groundwater samples have been collected from 23 monitoring well and boring locations. Elevated concentrations of petroleum hydrocarbons and PAHs remain in soil in the vicinity of FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E as a result of the historical leak at the valve box at Berth 10. The abundance of utility piping at this location provided multiple migration pathways, resulting in a widespread distribution of the released fuel. Although elevated concentrations of the petroleum hydrocarbons and PAHs were also detected in grab groundwater samples collected in the vicinity of these FOPL segments in 2002, analytical data for samples collected in groundwater monitoring wells 117W01 through 117W05 during 2003 suggest that contamination is not migrating downgradient and is not discharging to the Strait. Temporal analytical data for these wells indicate that constituent degradation is occurring through natural attenuation. In addition, a baseline ERA was performed for this site and concluded that constituents in groundwater at FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E do not pose a significant risk to aquatic organisms in the Strait. The methodology behind and results of the baseline ERA are provided in Attachment D1 of Appendix D. Furthermore, an assessment on the potential degradation of groundwater (Section 1.4-2) concluded that previous releases from these FOPL segments have not resulted in a significant impact to Mare Island Strait.

A Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) to evaluate the potential risk from TPH-diesel, TPH-motor-oil, TPH-fuel-oil, and various PAHs in soil and TPH-diesel, TPH-motor-oil, benzo(a)anthracene, benzo(a)pyrene, chrysene, and fluorene in groundwater. These analytes were detected in samples collected along the FOPL segments at concentrations exceeding Tier 1 ESLs for industrial sites. The Tier 2 screening levels for these analytes in soil and groundwater are presented in Tables 1.4-3 and 1.4-4, respectively. Previous soil and pipeline removal actions have removed the suspected source area; however, a few isolated areas of benzo(a)pyrene contamination in soil remain at the site. Soil boring locations BE10GB0100, B121VB006, and B121VB008 have concentrations of benzo(a)pyrene above the Tier 2 screening level and are driving human health risk for the site. The EPCs for the remaining COPCs in soil and groundwater are below the corresponding Tier 2 screening levels.

Because the EPC for benzo(a)pyrene in soil is greater than the corresponding Tier 2 screening level, an interim remedial action should be performed to address contaminated soil in the vicinity of FOPL segments G1/10/7E, G1/10/BE10, and G1/6/7E. Soil will be removed to approximately 11 feet bgs at BE10GB0100 and 5 feet bgs at B121VB006 and B121VB008. Each excavation area will be approximately 10 feet by 10 feet, for a total soil excavation volume of approximately 80 cubic yards. The approximate excavation areas are presented in Figure 3.2-1.

Approximately five confirmation samples will be collected from each excavation area. One sample will be collected from each excavation's side walls, and one sample will be collected from the bottom of each excavation. Sidewall samples will be collected at depths of approximately 3 to 4 feet bgs. Soil samples will be analyzed for TPH-diesel, TPH-motor-oil, and PAHs. Analytical results from the confirmation samples will be evaluated to determine if further excavation is necessary. Excavation will be considered complete if petroleum hydrocarbons or PAHs are quantified at concentrations below Tier 2 screening levels. If elevated concentrations of petroleum hydrocarbons or PAHs are detected, further excavation will be performed, or a new EPC will be calculated and compared to the Tier 2 screening levels for the site to determine if concentrations at the site following excavation present a potential significant human health risk.

4.3 FOPL Segment G1/X/BE10

4.3.1 Site Description

FOPL segment G1/X/BE10 is located near Berth 10 in IA C1 in an area with a proposed mixed (industrial) future land use (Figure 2.2-2). The FOPL segment is 169 feet long. The southern end of this FOPL segment is connected to FOPL segment G1/6/7E, and the northern end of this FOPL segment is connected to FOPL segment G1/6/B971 (Figure 2.4-1). The depth at which this pipeline is buried is approximately 7 feet bgs. Groundwater is located at approximately 7 to 8 feet bgs and flows to the northeast towards Mare Island Strait (Figure 2.5-1). The FOPL segment is located approximately 55 feet away from Mare Island Strait at its eastern end. This FOPL segment is located in an area with a surface elevation of 10 to 12 feet above msl.

4.3.2 Previous Actions and Investigations

No attempts were made during previous investigations to locate FOPL segment G1/X/BE10. This FOPL segment was identified during a review of historical Navy maps in 2002. However, soil samples were collected in the vicinity of this FOPL segment during previous investigations of FOPL segment G1/6/WTRF and the Berth 10 Area. Sample 049 was collected beneath FOPL segment G1/6/WTRF following removal of this pipeline in 1997. The sample was collected from 5 feet bgs and analyzed for TPH-fuel-oil, BTEX compounds, and PAHs (Weston 2001). Four soil samples were collected from BE10GB0102 at 1.5, 4.5, 7.5, and 15.5 feet bgs in 2002 and analyzed for petroleum hydrocarbons and PAHs. A grab groundwater sample was also collected from this boring and analyzed for petroleum hydrocarbons and PAHs. This sampling was performed consistent with the *Draft Sampling and Analysis Plan for Investigation Area C1* (CH2M HILL 2002f).

4.3.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment G1/X/BE10 were required following the previous investigation. A geophysical survey was performed along FOPL segment G1/X/BE10 during October 2002 in an attempt to locate the FOPL segment using GPR and metal-detection equipment. The results of the GPR survey are presented on Plate 26 in Appendix C. A pipeline suspected of being the FOPL was identified during the survey. A trench was consequently advanced at the eastern end of FOPL segment G1/X/BE10 in July 2003 to confirm the presence of this pipeline. The trench was advanced approximately 21 feet in the direction perpendicular to the suspected orientation of the FOPL (east-west) at the location presented in Figure 3.2-1. The trench was advanced to approximately 8 feet bgs. A steel pipeline suspected of being the FOPL was exposed at 7.4 feet bgs. The pipeline has the same orientation as FOPL segment G1/X/BE10 and is 4 inches in diameter. A petroleum hydrocarbon sheen was observed on the free-standing water that collected in the trench.

Two borings (FOPLBE10GB0105 and FOPLBE10GB0106) were advanced in June 2003 to characterize contamination along this FOPL segment. Soil samples were collected at 5 and 12 feet bgs in each of these borings and analyzed for TPH-diesel and TPH-motor-oil. The sample collected from 5 feet bgs at FOPLBE10GB0106 was also analyzed for PAHs. Soil between 9 to 12.5 feet bgs in FOPLBE10GB0106 was stained and had a petroleum hydrocarbon odor. A PID of 21 ppm was recorded in the headspace of this soil.

Two borings (FOPLBE10GB0106A and FOPLBE10GB0106B) were advanced downgradient (northeast) of FOPLBE10GB0106 in July and August 2003 due to the presence of elevated concentrations of petroleum hydrocarbons in this boring (presented in the following section). Soil samples were collected from 5, 8, and 11 feet bgs at FOPLBE10GB0106A and from 8 feet bgs at FOPLBE10GB0106B. A groundwater sample was also collected from FOPLBE10GB0106A. No unusual visual or olfactory observations were made during drilling of borings FOPLBE10GB0106A and FOPLBE10GB0106B, and organic vapors were not detected with a PID.

4.3.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAH contamination in soil and groundwater in the vicinity of FOPL segment G1/X/BE10 were defined by sampling efforts performed during previous and recent investigations. Eleven soil and two grab groundwater samples have been collected along this 169-foot segment.

4.3.4.1 Nature and Extent of Soil Contamination

Elevated concentrations of petroleum hydrocarbons have been detected near the northern end of FOPL segment G1/X/BE10, as presented in Figure 3.2-1. TPH-diesel and TPH-motor-oil were detected at concentrations of 3,800 and 3,500 mg/kg, respectively, in a soil sample collected at 12 feet bgs at FOPLBE10GB0106 in 2003. Consequently, a step-out boring (FOPLBE10GB0106A) was advanced to define the lateral extent of this contamination downgradient of FOPLBE10GB0106. TPH-diesel was detected at a concentration of 4,300 mg/kg in this step-out boring at 8 feet bgs. TPH-motor-oil was not detected in samples collected from this boring. TPH-diesel was not detected in the sample collected

from 11 feet bgs at this location, indicating that the vertical extent of contamination was defined. Due to the elevated concentration of TPH-diesel at FOPLBE10GB0106A, a step-out boring (FOPLBE10GB0106B) was advanced downgradient of FOPLBE10GB0106A. TPH-diesel and TPH-motor-oil were only detected at low concentrations (below 100 mg/kg) in a sample collected from 8 feet bgs at FOPLBE10GB0106B. This result defined the eastern extent of soil contamination near the northern end of FOPL segment G1/X/BE10. Soil samples collected from FOPLBE10GB0105 and BE10GB0102, which are located near the southern end of the FOPL segment, contained only very low concentrations of petroleum hydrocarbons.

BTEX compounds were not detected at concentrations exceeding analytical reporting limits (Figure 3.1-2). As presented in Figure 3.1-3, the only PAH to be detected in soil samples collected adjacent to FOPL segment G1/X/BE10 at a concentration exceeding the analytical reporting limit is acenaphthene. Acenaphthene was detected at a concentration of 0.25 mg/kg, which is significantly below the Tier 1 ESL for this analyte (19 mg/kg).

A Tier 2 risk analysis was performed based on the site-specific conditions of FOPL segment G1/X/BE10 to derive Tier 2 screening levels for TPH-diesel and TPH-motor-oil, which were detected at concentrations exceeding the corresponding Tier 1 ESLs. The methodology used in the Tier 2 risk analysis is presented in Appendix D. The Tier 2 screening level for TPH-diesel and TPH-motor-oil in soil is 10,000 mg/kg (Table 1.4-3). TPH-diesel and TPH-motor-oil were detected at concentrations less than this value, suggesting that contamination at this site does not present a significant risk to human health or the environment.

4.3.4.2 Nature and Extent of Groundwater Contamination

Elevated concentrations of TPH-diesel were detected in one grab groundwater sample collected in the vicinity of FOPL segment G1/X/BE10. The sample collected from FOPLBE10GB0106A in 2003 contained TPH-diesel at a concentration of 850 µg/L (Figure 3.2-1). This concentration exceeds the Tier 1 ESL for TPH-diesel (640 µg/L). The concentration of TPH-diesel detected in groundwater collected from BE10GB0102 in 2002 is below the Tier 1 ESL. TPH-motor-oil was not detected in either of these samples at concentrations exceeding analytical reporting limits.

Groundwater monitoring well FOPLWTRFMW0100 was installed roughly downgradient of FOPLBE10GB0106A. Groundwater sampled from this well in August 2003 did not contain TPH-diesel or TPH-motor-oil at concentrations above analytical reporting limits. Analytical data for groundwater collected from monitoring wells are considered more representative of groundwater conditions than data from grab groundwater samples. (Grab samples are not filtered prior to analysis and may contain soil particulate matter that can bias TPH concentrations high in areas with petroleum hydrocarbon contamination in soil.) In addition, FOPLWTRFMW0100 is located approximately 20 feet upgradient of Mare Island Strait, so data collected from this well are more representative of groundwater conditions at the Strait. Based on this information, it is determined that petroleum hydrocarbons are not being released to Mare Island Strait due to releases from FOPL segment G1/X/BE10.

The only PAHs to be detected at concentrations exceeding analytical reporting limits are acenaphthene and fluorene; however, both of these analytes were detected at concentrations

well below the corresponding Tier 1 ESL. These concentrations were detected in the groundwater sample collected from FOPLBE10GB0106A (Figure 3.1-3). These groundwater samples were not analyzed for BTEX compounds.

A Tier 2 risk analysis was performed based on the site-specific conditions of FOPL segment G1/X/BE10 to derive a Tier 2 screening level for TPH-diesel detected at FOPLBE10GB0106A. The methodology for deriving the Tier 2 screening levels at FOPL segment G1/X/BE10 is provided in Appendix D. The Tier 2 screening level for TPH-diesel in groundwater is 50,000 µg/L (Table 1.4-4). TPH-diesel was detected at a concentration significantly below this level, indicating that groundwater contamination at the site does not pose a risk to human health or the environment.

4.3.5 Conclusions and Recommendations for Further Investigative and/or Remedial Action

Twelve soil samples and two groundwater samples were collected along this 169-foot span of FOPL between 1997 and 2003. While the analytical data suggest that a release has occurred to soil in the vicinity of FOPL segment G1/X/BE10, a Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) to evaluate the potential risk from TPH-diesel and TPH-motor-oil in soil and TPH-diesel in groundwater at FOPL segment G1/X/BE10. These analytes were detected in samples collected along FOPL segment G1/X/BE10 at concentrations exceeding Tier 1 ESLs for industrial sites. The Tier 2 screening levels for these analytes in soil and groundwater are presented in Tables 1.4-3 and 1.4-4, respectively. All COPCs were detected at concentrations less than the corresponding Tier 2 screening levels. In addition, a baseline ERA concluded that constituents in groundwater at FOPL segment G1/X/BE10 do not pose a significant risk to aquatic organisms in the Strait. The methodology behind and results of the baseline ERA are provided in Attachment D1 of Appendix D. Further, an assessment on the potential degradation of groundwater (Section 1.4.2) concluded that releases from this FOPL segment have not resulted in a significant impact to Mare Island Strait.

FOPL segment G1/X/BE10 was located and exposed during exploratory trenching performed during 2003. Therefore, the source of potential soil and groundwater contamination remains at this site, and a remedial action should be performed. The two ends of FOPL segment G1/X/BE10 will be exposed through trenching, and the pipeline will be cut (if necessary) using cold-tapping procedures and drained (if necessary). A vacuum will then be applied to the segment. If the pipeline successfully holds a vacuum of 5 inches mercury for 30 minutes with less than a 10 percent deviation in the vacuum, the pipeline will be considered to be absent of fractures and will subsequently be flushed and sealed with concrete caps. If a vacuum cannot be maintained, pressure testing may be performed to isolate the point of fracture. However, further investigative or remedial action will be based on pipeline conditions encountered in the field and will be performed in collaboration with regulatory agencies.

4.4 FOPL Segment G1/6/B971

4.4.1 Site Description

FOPL segment G1/6/B971 is located near Berth 10 in an area of IA C1 with a proposed mixed (industrial) future land use area (Figure 2.2-2). The FOPL segment is 175 feet long and has a 6-inch diameter. The FOPL segment connects with FOPL segment G1/X/B493 near Building 493 at its western end and with FOPL segment G1/X/BE10 at its eastern end (Figure 2.4-1). The depth of this pipeline is unknown. The eastern end of the FOPL segment is located approximately 140 feet from Mare Island Strait.

4.4.2 Previous Actions and Investigations

An attempt was made to locate this FOPL segment using GPR during an investigation of the FOPL performed between 1996 and 1999, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). The FOPL was not located during this investigation.

Soil samples have been collected adjacent to the suspected location of the FOPL segment during previous investigations of DOM No. 6 and the Berth 10 Area. One direct-push boring (BE10GB007) and one vacuum excavation (BE10VB009) were advanced in 1998 during an investigation to characterize contamination associated with the 1991 release from the FOPL in the Berth 10 Area. Information of the 1991 release is presented in Section 4.2.2 of this report. Two soil samples were collected from BE10GB007 (at 7.5 and 17 feet bgs), and one soil sample was collected from BE10VB009 (at 6.5 feet bgs). Soil samples were submitted for analysis of TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX compounds (TtEMI 2001c).

Eight soil samples and one groundwater sample were collected from DOM6GB001 during a 1997 investigation of DOM No. 6. The purpose of this investigation was to better define the nature and extent of soil and groundwater contamination as part of the remedial investigation for this site. Soil samples were analyzed for TPH-gasoline, TPH-diesel, TPH-motor-oil, BTEX compounds, PAHs, pesticides, and PCBs. The groundwater sample was analyzed for TPH-gasoline, TPH-diesel, TPH-motor-oil, BTEX compounds, and PAHs (CH2M HILL 2002f).

4.4.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment G1/6/B971 were required following the previous investigations of the Berth 10 Area and DOM No. 6. A geophysical survey was performed in October 2002 to locate FOPL segment G1/6/B971 using GPR and metal-detection equipment. The survey was performed at a location east of Building 971. The results of this survey are presented on Plate 27 of Appendix C. An unidentified subsurface utility suspected of being the FOPL was located during the survey. Consequently, an exploratory trench was advanced at a location approximately 11.5 feet east of Building 971 in June 2003 to determine if the FOPL is present. The trench was first advanced to approximately 10 feet in the east-west direction and 14 feet in the north-south direction. The trench was advanced to approximately 14 feet bgs. Although the FOPL was not located in the trench, hydrocarbon odors and staining were detected as shallow as 7 feet bgs, and separate-phase hydrocarbons were observed in clay

fractures at approximately 11 feet bgs (along the northern sidewall of the trench). Separate-phase hydrocarbons migrated into the excavation when wood debris was exposed at 12 to 13 feet bgs in the trench. A pool of separate-phase hydrocarbons quickly accumulated at the base of this excavation when the backhoe advanced through the wood. Soil samples were collected at 5 and 13 feet bgs. The extent of the trench was increased by approximately 10 feet to the east along the northern edge of the trench to define the extent of separate-phase hydrocarbons. The lateral extent of separate-phase hydrocarbons in the downgradient direction could not be defined during trenching operations. These results suggest that although the FOPL is no longer present at this location, previous use of the FOPL has resulted in releases of petroleum hydrocarbons to the subsurface.

Seven borings (FOPLB971GB0101A through FOPLB971GB0101G) were advanced at locations up to 80 feet upgradient and downgradient of the trench in June, July, and August 2003 to define the extent of contamination detected in samples collected from the exploratory trench. One to three soil samples were collected from each boring at depths ranging from 5 to 20 feet bgs. Soil samples were analyzed for TPH-diesel, TPH-motor-oil, and, in some cases, PAHs. An attempt was made to collect a groundwater sample immediately downgradient of the trench at FOPLB971GB0101A; however, only separate-phase hydrocarbons could be extracted from the temporary PVC well set at this location. The screen interval of the PVC was set at 10 to 20 feet bgs. The direct-push rig could not advance past 7 feet bgs at FOPLB971GB0101D due to the presence of wood at this depth.

An additional boring (FOPLB971GB0100) was advanced during June 2003 to satisfy the requirement that samples be collected at intervals of 100 feet along non-located FOPL segments. Soil samples were collected from this boring at 5 and 12 feet bgs and analyzed for TPH-diesel and TPH-motor-oil.

Significant observations made during drilling operations at borings along FOPL segment G1/6/B971 are presented in Table 4.4-1. These observations are documented in the lithologic logs presented in Appendix B.

TABLE 4.4-1

Significant Observations Made During Drilling at FOPL Segment G1/6/B971 in 2003
Site Characterization Report, Site Closure Report, and Interim Remedial Action Work Plan for IA B and IA C1 FOPL Segments, Lennar Mare Island, Vallejo, California

Location	Depth of Staining and/or Odor	Depth of Separate Phase Hydrocarbons	Maximum PID reading and depth
FOPLB971GB0101A	9 to 20 feet bgs	16 to 20 feet bgs	90 ppm at 17.5 feet bgs
FOPLB971GB0101B	14 to 18 feet bgs	-- ^b	-- ^a
FOPLB971GB0101C	7.5 to 12.5 feet bgs	16 to 17.5 feet bgs	57.4 ppm at 7.5 feet bgs
FOPLB971GB0101E	17 to 17.5 feet bgs	-- ^b	-- ^a
FOPLB971GB0101F	18 to 20 feet bgs	-- ^b	-- ^a

--^a No VOCs detected with PID.

--^b Separate-phase hydrocarbons were not observed during drilling.

4.4.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAH contamination in soil and groundwater in the vicinity of FOPL segment G1/6/B971 were defined by sampling efforts performed during previous investigations of DOM No. 6 and the Berth 10 Area and recent investigations of the FOPL. Twenty-six soil samples and one grab groundwater sample have been collected along this 175-foot segment.

4.4.4.1 Nature and Extent of Soil Contamination

Elevated concentrations of TPH-diesel and TPH-motor-oil have been detected in soil samples collected along FOPL segment G1/6/B971. The maximum concentration of TPH-diesel (33,000 mg/kg) was detected in a sample collected from 13 feet bgs in the trench advanced directly east of Building 971. This location is presented as FOPLB971SS0100 in Figure 3.2-1. TPH-motor-oil was detected in this sample at a concentration of 7,500 mg/kg. Separate-phase hydrocarbons were also observed at this depth in the trench. The vertical extent of contamination at this location is not defined. However, analytical results for a sample collected from 17 feet bgs at BE10GB007, which is approximately 10 feet southeast of FOPLB971SS0100, indicate that petroleum hydrocarbons are present at significantly lower concentrations at this depth interval. TPH-diesel and TPH-motor-oil were not detected above analytical reporting limits in this sample, and TPH-fuel-oil was detected at a concentration of 1,300 mg/kg.

Analyses for TPH-diesel and TPH-motor-oil in soil samples collected from borings east and west of the exploratory trench quantified elevated concentrations of petroleum hydrocarbons at locations approximately 80 feet to the west of the exploratory trench and 50 feet east (downgradient) of the exploratory trench. Downgradient of the trench, elevated concentrations of TPH-diesel and TPH-motor-oil (up to 5,400 and 7,400 mg/kg, respectively) were detected from 6.5 to 18 feet bgs (Figure 3.2-1). West of the trench, elevated concentrations of TPH-diesel and TPH-motor-oil (up to 7,200 and 11,000 mg/kg, respectively) were detected at 16 to 19.5 feet bgs. The greatest TPH-motor-oil concentration detected at this FOPL segment (11,000 mg/kg) was detected at DOMGB001 in 1997. The contamination at this location is vertically delineated. This location is approximately 70 feet upgradient (west) of the separate-phase hydrocarbons observed in the exploratory trench.

The source of the separate-phase hydrocarbons observed at the site has not been confirmed. The hydrocarbons are likely either present as a result of releases from former FOPL segment G1/6/B971 or as a result of the 1991 release near the valve box at the intersection of FOPL segments G1/6/7E and G1/6/WTRF. This valve box is adjacent to a sanitary sewer line that extends north and west to DOM No. 6 (Figure 2.4-1). A video camera survey performed in the sanitary sewer line in 1991 clearly showed diesel fuel entering the sanitary sewer line (at joints and cracks) near the valve box. Floating product was also observed in DOM No. 4 and DOM No. 6 as a result of this release (PRC 1991), indicating that separate-phase hydrocarbons previously migrated to the vicinity of FOPL segment G1/6/B971. It is possible that this 1991 release, which occurred approximately 150 feet southeast of the location where separate-phase hydrocarbons were observed in 2003, has resulted in the contamination detected in the vicinity of FOPL segment G1/6/B971.

Eleven samples collected during previous investigations were analyzed for BTEX compounds. Toluene and xylenes were detected in five of these samples at maximum concentrations of 0.003 and 0.002 mg/kg, respectively (Figure 3.1-2). These concentrations are below the corresponding Tier 1 ESLs. Of the 14 samples analyzed for PAHs, elevated concentrations (i.e., above Tier 1 ESLs) were only detected in the sample collected from 13 feet bgs in exploratory trench (FOPLB971SS0100). This sample contained the maximum concentration of TPH-diesel at the site. Fluorene and anthracene were detected in this sample at concentrations of 14 and 24 mg/kg, respectively. Other PAHs were also detected

in samples collected from DOMGB001, FOPLB971GB0101B, FOPLB971GB0101C, FOPLB971GB0101D, and FOPLB971GB0101E, as presented in Figure 3.1-3.

A Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) to evaluate the potential risk from TPH-diesel, TPH-fuel-oil, TPH-motor-oil, anthracene, and fluorene in soil. These analytes were detected at concentrations exceeding Tier 1 ESLs for industrial sites. The Tier 2 screening levels are provided in Table 1.4-3, and the methodology for deriving the Tier 2 screening levels at FOPL segment G1/6/B971 is provided in Appendix D. Because the EPC presented in Table 1.4-3 for TPH-diesel for depths greater than 10 feet bgs is greater than the corresponding Tier 2 screening level, a remedial action should be performed to address contaminated soil in the vicinity of exploratory trench FOPLB971SS0100 at FOPL segment G1/6/B971. Impacted soil will be excavated as an interim remedial action for the FOPL (Section 4.4.5).

4.4.4.2 Nature and Extent of Groundwater Contamination

One groundwater sample was collected along FOPL segment G1/6/B971. This sample was collected from DOMGB001 in 1997. TPH-diesel, TPH-motor-oil, acenaphthene, fluoranthene, and pyrene were detected in this sample at concentrations of 1,000, 900, 2, 0.6, and 1 µg/L, respectively. The TPH-diesel and TPH-motor-oil concentrations are greater than the Tier 1 ESL for these analytes (640 µg/L). However, analytical data from monitoring well FOPLWTRFMW0100 (positioned downgradient of FOPL segment G1/6/B971) are considered more representative of existing groundwater conditions near the Strait than data from the 1997 grab sample because: (1) the monitoring well is located downgradient of both the FOPL segment and DOMGB001 and is closer to the Strait; (2) samples collected from the monitoring well were collected from 2003, while samples collected from DOMGB001 were collected in 1997; and (3) unfiltered grab groundwater samples from DOMGB001 potentially contain soil particulate matter that can bias petroleum hydrocarbon concentrations in groundwater high. Analytical data for a sample collected from FOPLWTRFMW0100 in August 2003 indicate that elevated concentrations of petroleum hydrocarbons are not discharging to the Strait; TPH-diesel and TPH-motor-oil were not detected in this sample at concentrations exceeding analytical reporting limits.

To be conservative, a Tier 2 risk analysis was performed due to the elevated concentrations of TPH-diesel and TPH-motor-oil detected in groundwater at DOMGB001. Tier 2 screening levels were developed based on the site-specific conditions of FOPL segment G1/6/B971 and in accordance with RWQCB guidance (RWQCB 2003). The Tier 2 screening level for TPH-diesel and TPH-motor-oil in groundwater is 50,000 µg/L (Table 1.4-4). TPH-diesel and TPH-motor-oil were detected at concentrations significantly below this level, indicating that groundwater contamination at the site does not pose a risk to human health or the environment.

4.4.5 Conclusions and Recommendations for Further Investigative and/or Remedial Action

The analytical data suggest that a release occurred to soil and groundwater in the vicinity of this FOPL segment G1/6/B971. Fourteen of 26 soil samples collected along this FOPL segment contained petroleum hydrocarbons and/or PAHs at concentrations exceeding Tier 1 ESLs for industrial sites.

A Tier 2 risk analysis was performed to evaluate the potential risk from TPH-diesel, TPH-fuel-oil, TPH-motor-oil, anthracene, and fluorene in soil and TPH-diesel and TPH-motor-oil in groundwater. The Tier 2 screening levels are provided in Tables 1.4-3 and 1.4-4 and the methodology for deriving the Tier 2 screening levels at FOPL segment G1/6/B971 is provided in Appendix D. Because the EPC presented in Table 1.4-3 for TPH-diesel for soil greater than 10 feet bgs is greater than the corresponding Tier 2 screening level, a remedial action should be performed to address deep contaminated soil (greater than 10 feet bgs) in the vicinity of FOPL segment G1/6/B971. The EPCs for TPH-motor-oil, anthracene, and fluorene in soil and TPH-diesel and TPH-motor-oil in groundwater were less than the corresponding Tier 2 screening levels. In addition, a baseline ERA was performed for this site and concluded that constituents in groundwater at FOPL segment G1/6/B971 do not pose significant risk to aquatic organisms in the Strait.

Soil will be removed to approximately 15 feet bgs at previous sample location FOPLB971SS0100 for a total soil excavation volume of approximately 330 cubic yards (assuming each excavation has a planar area of 30 feet by 20 feet). The approximate excavation area is presented in Figure 3.2-1. Approximately five confirmation samples will be collected (four samples collected from the excavation sidewalls and one sample collected from the bottom of the excavation). Sidewall samples will be collected at a depth of approximately 13 feet bgs. Soil samples will be analyzed for TPH-diesel. Soil samples containing TPH-diesel in confirmation soil samples at concentrations greater than Tier 1 ESLs will also be analyzed for PAHs. Analytical results from the confirmation samples will be evaluated to determine if further excavation is necessary. Excavation will be considered complete if TPH-diesel is quantified in confirmation soil samples at concentrations below the Tier 2 screening level (10,000 mg/kg). If elevated concentrations of petroleum hydrocarbons are detected, further excavation will be performed, or a new EPC will be calculated and compared to the Tier 2 screening level for the site to determine if concentrations at the site following excavation present a potential significant human health risk.

4.5 FOPL Segment G1/4/BE3BE8

4.5.1 Site Description

FOPL segment G1/4/BE3BE8 is located in IA C1 along Berth 8 (Figure 2.4-1). The FOPL segment is located in an area with a proposed mixed (industrial) future land use (Figure 2.2-2). The FOPL segment consists of two parallel pipelines. They are 4 inches in diameter and, in conjunction with FOPL segments H1/4/BE3BE8 and 1/4/BE3BE8, are part of a “supply and return” fuel-oil distribution system that extends between Berth 3 and Berth 8. FOPL segment G1/4/BE3BE8 is 754 feet long. This FOPL segment is buried at depths ranging from approximately 2 to 3.5 feet bgs.

4.5.2 Previous Actions and Investigations

A field investigation was performed along this FOPL segment during 1996 and 1997, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). The pipelines that compose FOPL segment G1/4/BE3BE8 at Berth 8 were removed. Three soil samples (055 through 057) were collected following pipeline removal. Based on information

presented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001), it is concluded that an unspecified quantity of contaminated soil was excavated at sample locations 055 and 057. Confirmation samples (055A and 057A) were collected at each of these locations following over-excavation. Each soil sample was analyzed for petroleum hydrocarbons and BTEX compounds.

4.5.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment G1/4/BE3BE8 were required following the previous investigation of the FOPL. Four borings (FOPLBE3BE8GB0100, FOPLBE3BE8GB0102, FOPLBE3BE8GB0106A, and FOPLBE3BE8GB0107A) were advanced during May, June, and October 2003. Borings FOPLBE3BE8GB0100 and FOPLBE3BE8GB0102 were advanced to satisfy the criteria that samples be collected at a frequency of every 100 feet along removed segments in industrial areas. Samples were collected from FOPLBE3BE8GB0107A to confirm the presence of contamination previously detected in sample 055. An attempt was made to collect a soil sample at FOPLBE3BE8GB0106A to confirm the previous detected concentrations of petroleum hydrocarbons at this location in sample 056. However, there was no soil recovery in the sample sleeve during drilling. One to two soil samples were collected from each boring at depths equal to and below the approximate former depth of the pipeline (3 to 7 feet bgs). Soil samples were analyzed for TPH-diesel and TPH-motor-oil. The soil sample collected from FOPLBE3BE8GB0107A was also analyzed for PAHs. A groundwater sample was collected at FOPLBE3BE8GB0106A to determine if previous releases to soil had impacted water quality directly downgradient of the FOPL. The groundwater sample was analyzed for TPH-diesel, TPH-motor-oil, and PAHs. No unusual visual or olfactory observations were made during drilling, and organic vapors were not detected with a PID.

4.5.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon, BTEX, and PAH contamination in soil and groundwater in the vicinity of FOPL segment G1/4/BE3BE8 were defined by sampling efforts performed during recent and previous investigations of the FOPL. Seven soil samples and one groundwater sample were collected along this FOPL segment.

4.5.4.1 Nature and Extent of Soil Contamination

Elevated levels of petroleum hydrocarbons (up to 1,600 mg/kg) were detected in soil at three locations (055, 056, and 057) and at 2 to 3.5 feet bgs following removal of the pipeline in 1996 and 1997. However, analytical data collected following over-excavation of contaminated soil at 055 and 057 suggest that elevated levels of petroleum hydrocarbons only remain at sample location 056. Confirmation samples collected at 5.5 feet bgs (055A and 057A) did not contain TPH-diesel above laboratory limits (10 mg/kg). TPH-diesel and TPH-fuel-oil remain at 056 at concentrations of 1,300 mg/kg and 1,400 mg/kg (Figure 3.8-1).

During the 2003 sampling event, FOPLBE3BE8GB0107A was advanced and soil samples were collected to confirm the presence of previously detected TPH concentrations in soil at previous sample location 055. FOPLBE3BE8GB0107A was advanced a few feet down-gradient of 055 and 055A to confirm that contaminated soil was effectively excavated at this

location in 1997. TPH-diesel was detected at a concentration of 2,200 mg/kg at a depth of 7 feet bgs, indicating that the previous excavation did not effectively remove all contaminated soil. This sample was collected 4 feet below previous confirmation sample 055A, suggesting that the previous excavation did not go deep enough.

The remaining soil samples collected during 2003 quantified only low levels (up to 67 mg/kg) of TPH-diesel and TPH-motor-oil. These results indicate that elevated levels of petroleum hydrocarbons only remain at two locations along FOPL segment G1/4/BE3BE8 (056 and FOPLBE3BE8GB0107A). Due to poor soil recovery in FOPLBE3BE8GB0106A, the elevated concentration previously detected at 056 could not be confirmed during 2003.

Three soil samples were submitted for analysis of BTEX compounds and PAHs during 1997. BTEX compounds were not detected above laboratory reporting limits in any of the soil samples (Weston 2001). Of the soil samples that are representative of existing conditions, elevated concentrations of PAHs were detected at one location (056). Benzo(a)pyrene was detected in this sample at a concentration of 0.18 mg/kg. This concentration exceeds the Tier 1 ESL for this analyte (0.13 mg/kg). Elevated concentrations of PAHs were also detected in the soil sample collected at FOPLBE3BE8GB0107A at 7 feet bgs in 2003. Acenaphthene, anthracene, benzo(a)anthracene, chrysene, fluoranthene, fluorene, naphthalene, and pyrene were each detected in this sample at respective concentrations of 100, 82, 24, 24, 160, 96, 33, and 120 mg/kg (Figure 3.1-3). These concentrations exceed the corresponding Tier 1 ESLs for these analytes.

A Tier 2 risk analysis was performed based on the site-specific conditions of FOPL segment G1/4/BE3BE8 to derive Tier 2 screening levels for analytes that were detected at concentrations exceeding Tier 1 ESLs along this FOPL segment. The methodology used to perform the Tier 2 risk analysis is presented in Appendix D. The Tier 2 screening levels for TPH-diesel, TPH-fuel-oil, benzo(a)pyrene, acenaphthene, anthracene, benzo(a)anthracene, chrysene, fluoranthene, fluorene, naphthalene, and pyrene in soil are presented in Table 1.4-3. Benzo(a)anthracene and chrysene were detected at concentrations exceeding the Tier 2 screening levels. This indicates that a remedial action is warranted to protect groundwater and to reduce the human health risk created by direct exposure to PAHs in soil.

4.5.4.2 Nature and Extent of Groundwater Contamination

One groundwater sample was collected along these FOPL segments and analyzed for TPH-diesel, TPH-motor-oil, and PAHs. The sample was collected from FOPLBE3BE8GB0106A in 2003. TPH-diesel, TPH-motor-oil, and PAHs were not detected in this sample at concentrations exceeding analytical reporting limits. This result suggests that previous use of these FOPL segments has not resulted in an impact to groundwater at the site.

4.5.5 Conclusions and Recommendations for Further Investigative and/or Remedial Action

The entire length of FOPL segment G1/4/BE3BE8 has been removed. Therefore, any source of potential soil and groundwater contamination from this FOPL segment has been removed. This site has been adequately characterized. Seven soil samples and one

groundwater sample were collected along this 754-foot span of FOPL between 1997 and 2003. The analytical data suggest that a release has occurred to soil in the vicinity of FOPL segment G1/4/BE3BE8. Elevated concentrations of petroleum hydrocarbons and PAHs were detected in soil samples collected along this FOPL segment. Analytical data for the groundwater sample collected at the site suggest that previous releases to soil have not resulted in an impact to groundwater.

A Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) to evaluate the potential risk from TPH-diesel, TPH-fuel-oil, and select PAHs in soil at FOPL segment G1/4/BE3BE8. The Tier 2 screening levels for these analytes in soil are presented in Table 1.4-3. Benzo(a)anthracene and chrysene were detected at FOPLBE3BE8GB0107A at concentrations exceeding the corresponding Tier 2 screening levels. Consequently, a remedial action will be performed to remove elevated concentrations of these COPCs. Soil will be removed to approximately 10 feet bgs at previous sample location FOPLBE3BE8GB0107A for a total soil excavation volume of approximately 37 cubic yards (assuming the excavation has a planar area of 10 feet by 10 feet). The approximate excavation area is presented in Figure 3.8-1. Approximately five confirmation samples will be collected (four samples collected from the excavation sidewalls and one sample collected from the bottom of the excavation). Sidewall samples will be collected at approximately 7.0 feet bgs. Soil samples will be analyzed for TPH-diesel, TPH-motor-oil, and PAHs. Analytical results from the confirmation samples will be evaluated to determine if further excavation is necessary. Excavation will be considered complete if PAHs and petroleum hydrocarbons are quantified at concentrations below the corresponding Tier 2 screening levels. If elevated concentrations of petroleum hydrocarbons or PAHs are detected, further excavation will be performed, or a new EPC will be calculated and compared to the Tier 2 screening levels for the site to determine if concentrations at the site following excavation present a potential significant human health risk or present a potential threat to groundwater.

4.6 FOPL Segment G1/2/B207

4.6.1 Site Description

FOPL segment is G1/2/B207 located in an area of IA C1 with proposed mixed (industrial) land use (Figure 2.2-2). FOPL segment G1/2/B207 has a 2-inch diameter and extends parallel to Nimitz Avenue between the intersections with FOPL segments G1/4/3ST and H1/2/B207B, as presented in Figure 2.4-1. This FOPL segment is 88 feet long. The depth of this pipeline is unknown, but was likely located a few feet bgs because it was present in a utility corridor beneath the sidewalk. This FOPL segment is located in an area with a surface elevation of 17 feet above msl. The FOPL segment is located approximately 500 feet away from Mare Island Strait, which is the closest surface water body.

4.6.2 Previous Actions and Investigations

FOPL segment G1/2/B207 has been included in two previous actions between 1997 and 2001. During 1997 and 1998, FOPL segment G1/2/B207 was removed from a sidewalk vault when the steam lines were installed in the area, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). No soil samples were collected along the removed portion of this segment during this investigation.

From 1999 to 2001, 48 soil and four grab groundwater samples were collected from 24 borings located in vicinity of Building 207, as documented in the *Fuel Pipeline Investigation Status Report for Buildings 85, 207, 257, 386, 388, and 390* (TtEMI and Washington 2001). The purpose of this investigation was to locate underground fuel lines and associated leaks, characterize the horizontal and vertical extent of soil and groundwater contamination, and identify and locate any additional sources of contamination. Three of the 24 borings (B207GB004, B207GB011, and B207GB018) were located in the vicinity of FOPL segment G1/2/B207. Two soil samples were collected from each boring from 5 to 10 feet bgs and analyzed for TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX compounds. In addition, one groundwater sample was collected (from B207GB011) and analyzed for TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX compounds. This investigation concluded that further investigation and sampling was required to assess the extent of TPH contamination in soil and groundwater at the Building 207 Area.

4.6.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment G1/2/B207 were required following the previous investigations. During May 2003, one boring (FOPLB207GB0100A) was advanced to confirm that potential releases from this FOPL segment did not result in significant concentrations of petroleum hydrocarbons in soil and groundwater downgradient of the FOPL segment. Two soil samples were collected from FOPLB207GB0100A at 6 and 9 feet bgs and submitted for analysis of TPH-diesel and TPH-motor-oil. One grab groundwater sample was collected from boring FOPLB207GB0100A and submitted for analysis of TPH-diesel, TPH-motor-oil, and PAHs. In addition, one soil sample was collected at the southern end of FOPL segment G1/2/B207 at the intersection with FOPL segment G1/X/B207B as part of the characterization of FOPL segment G1/X/B207B. The soil sample was collected from 6.5 feet bgs at FOPLB207GB0100 and analyzed for TPH-diesel and TPH-motor-oil. No unusual visual or olfactory observations were made during operations, and organic vapors were not detected with a PID.

4.6.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon and BTEX contamination in soil and petroleum hydrocarbon, BTEX, and PAH contamination in groundwater has been defined by samples collected during previous investigations. Nine soil samples and two groundwater samples have been collected along or downgradient of this FOPL segment.

4.6.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons were detected in soil at elevated concentrations in the vicinity of the FOPL segment G1/2/B207, as shown in Figure 3.8-1. Two soil samples collected from B207GB004 contained TPH compounds at concentrations exceeding Tier 1 ESLs. TPH-fuel-oil and TPH-motor-oil were detected at maximum concentrations of 6,400 mg/kg (8 feet bgs), and 18,000 mg/kg (6 feet bgs) in this boring in December 1999. Soil samples collected 15 feet downgradient of this boring in 2003 (from FOPLB207GB0100A) did not contain TPH-diesel or TPH-motor-oil at concentrations exceeding analytical reporting limits. The remaining soil samples collected along the FOPL segment only contain petroleum hydrocarbons at low concentrations. The only BTEX compounds detected in samples

collected along FOPL segment G1/2/B207 was ethylbenzene (at a concentration of 0.068 mg/kg) and xylene (at a concentration of 0.058J mg/kg). These analytes were detected in the sample collected from 8 feet bgs at B207GB004 (Figure 3.1-2).

A Tier 2 risk analysis was performed for FOPL segment G1/2/B207 due to the presence of elevated TPH-fuel-oil and TPH-motor-oil concentrations in soil at the site. The methodology used in the Tier 2 risk analysis is presented in Appendix D. The site-specific Tier 2 screening levels for TPH-fuel-oil and TPH-motor-oil in soil at FOPL segment G1/2/B207 is 10,000 mg/kg (Table 1.4-3). The EPC for TPH-motor-oil at this site (18,000 mg/kg) exceeds this Tier 2 screening level. Consequently, a remedial action should be performed to address elevated concentrations of TPH-motor-oil at the site that potentially contribute to risk to human health and/or the environment. A remedial action for this site is proposed in Section 4.6.5.

4.6.4.2 Nature and Extent of Groundwater Contamination

The groundwater sample collected in 2000 within 15 feet downgradient of FOPL segment G1/2/B207 contained TPH-motor-oil at a concentration of 780 µg/L. TPH-diesel, TPH-fuel-oil, and BTEX compounds were not detected in this sample at concentrations exceeding analytical reporting limits. The groundwater sample collected at FOPLB207AGB0100A in 2003 contained TPH-diesel and TPH-motor-oil at concentrations of 600 and 680 µg/L, respectively. This TPH-motor-oil concentration exceeds the Tier 1 ESL (640 µg/L). PAHs were not detected in this sample. FOPLB207GB0100A is located approximately 15 feet downgradient of B207GB004, which contained the maximum concentrations of petroleum hydrocarbons detected in soil along the FOPL segment.

A Tier 2 risk analysis was performed for FOPL segment G1/2/B207 due to the presence of elevated concentrations of TPH-motor-oil in groundwater at this site. The methodology used to perform the Tier 2 risk analysis is presented in Appendix D. The site-specific Tier 2 screening level for TPH-motor-oil in groundwater at FOPL segment G1/2/B207 is 50,000 µg/L (Table 1.4-4). Residual concentrations of TPH remaining in groundwater at this segment are significantly below this Tier 2 screening level.

4.6.5 Conclusions and Recommendations for Further Investigative and/or Remedial Action

The entire length of FOPL segment G1/2/B207 has been removed. Therefore, the source of potential soil and groundwater contamination was removed or remediated.

The site has been adequately characterized. Nine soil and two groundwater samples have been collected along or downgradient of this 88-foot segment. The analytical data suggest that a release has occurred to soil and groundwater along and approximately 15 feet downgradient this FOPL segment. A Tier 2 risk analysis was performed to derive Tier 2 screening levels for TPH-motor-oil in soil and groundwater. While the TPH-motor-oil concentrations in groundwater are significantly below the corresponding Tier 2 screening level, the EPC for TPH-motor-oil in soil (18,000 mg/kg) is greater than the corresponding Tier 2 screening level (10,000 mg/kg). Consequently, an interim remedial action will be performed to address contaminated soil in the vicinity of FOPL segment G1/2/B207. Soil will be removed at the location of boring B204GB004 (the only location found to contain

elevated concentrations of TPH-motor-oil) to approximately 8 feet bgs for a total excavation volume of approximately 30 cubic yards (assuming the excavation has a planar area of 10 feet by 10 feet). The approximate excavation area is presented in Figure 3.8-1.

Approximately five confirmation soil samples will be collected (four samples to be collected from the excavation sidewalls and one sample to be collected from the bottom of the excavation). Sidewall samples will be collected at approximately 6.0 feet bgs. Soil samples will be analyzed for TPH-motor-oil. Soil samples will also be analyzed for PAHs if TPH-motor-oil is detected at concentrations exceeding Tier 1 ESLs for industrial sites. Analytical results from the confirmation samples will be evaluated to determine if further excavation is necessary. Excavation will be considered complete if petroleum hydrocarbons are quantified at concentrations below Tier 2 screening levels. If elevated concentrations of petroleum hydrocarbons are detected, further excavation will be performed, or a new EPC will be calculated and compared to the Tier 2 screening levels for the site to determine if concentrations at the site following excavation present a potential significant human health risk.

Groundwater at the site has been impacted due to previous releases to soil from the FOPL. Further, the lateral extent of groundwater contamination is not defined in the downgradient direction. However, the source of contamination (the FOPL) is more than 250 feet from the Strait. Because of the immobility and highly biodegradable nature of TPH and related compounds, an impact to surface water from sites located more than 250 feet from a surface-water body is not likely to occur (Section 1.4.2). Therefore, previous releases of petroleum hydrocarbons from FOPL segment G1/2/B207 are not expected to result in a discharge of constituents to Mare Island Strait.

4.7 FOPL Segment H1/6/B85

4.7.1 Site Description

FOPL segment H1/6/B85 is located in an area of IA C1 with proposed mixed (industrial) land use (Figure 2.2-2). FOPL segment H1/6/B85 has 6-inch diameter and extends beneath Buildings 271 and 85 between FOPL segment H1/2/B89 and FOPL segments H1/2/B111 and H1/2/B85S (located south of Building 85) (Figure 2.4-1). The FOPL segment is located at approximately 3 feet bgs. The FOPL segment is located over 400 feet away from Mare Island Strait.

4.7.2 Previous Actions and Investigations

A field investigation was performed along this FOPL segment during 1996 and 1997, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). An attempt to locate FOPL segment H1/6/B85 using GPR and exploratory trenching was made during an investigation of the FOPL performed during 1998, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). The pipeline was not located during this investigation, which suggests that this pipeline is no longer present at this location. (The exploratory trench was advanced at the suspected location where FOPL segments H1/6/B85 and H1/2/B271 intersected. However, a review of historical Navy maps subsequent to this investigation suggests that FOPL segment H1/6/B85 may be present further west of the location of the exploratory trench advanced in 1998.)

Soil samples were collected from 11 borings located within Building 85 in 1999, as documented in the *Fuel Pipeline Investigation Status Report for Buildings 85, 207, 257, 386, 388, and 390* (TtEMI and Washington 2001). The purpose of this investigation was to locate underground fuel lines and associated leaks, characterize the horizontal and vertical extent of soil and groundwater contamination, and identify and locate any additional sources of contamination. Four direct-push borings (B085GB005 through B085GB008) and seven hand-auger borings (B085HA001 through B085HA007) were advanced in the vicinity of this FOPL segment during this investigation. One to three soil samples were collected from each boring and analyzed for TPH-diesel, TPH-fuel-oil, TPH-motor-oil, and BTEX compounds.

4.7.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment H1/6/B85 were required following the previous investigations. In October 2002, a geophysical investigation was performed in an attempt to locate the western end of FOPL segment H1/2/B85S and the southern end of FOPL segment H1/6/B85 using GPR and metal-detection equipment. The results of the GPR survey are presented on Plate 43 in Appendix C. Neither of the FOPL segments were located during this investigation.

In June 2003, exploratory trenching was performed at the southern end of FOPL segment H1/6/B85 to 4 feet bgs. The trench was approximately 15.5 feet long and 4 feet wide and was positioned diagonally across the suspected orientation of FOPL segment H1/2/B85S. FOPL segment H1/6/B85 was identified during trenching operations at this location at approximately 3 feet bgs. The pipeline was found capped with concrete at its southern end. Two soil samples were collected in the trench at depths of 3 and 4 feet bgs and submitted for analysis of TPH-diesel and TPH-motor-oil. The analytical results for these soil samples are presented in Section 3.17.4 and are evaluated with other data collected along FOPL segment H1/2/B85S in this section. An electrical charge was applied to the southern end of suspected FOPL segment H1/6/B85 to identify the distance over which the FOPL is present in the subsurface. The pipeline was detected in the subsurface over a distance of approximately 130 feet to the northwest (to the northern wall of Building 85).

Between July and October 2003, seven borings (FOPLB85GB0100, FOPLB85GB0101, FOPLB85GB0102A, FOPLB85GB0102B, FOPLB85GB0102C, FOPLB85GB0103A and FOPLB85GB0103B) were advanced in the vicinity of FOPL segment H1/6/B85. FOPLB85GB0100 and FOPLB85GB0101 were advanced along the suspected location of FOPL segment H1/6/B85 to satisfy the requirement that samples be collected at approximate 100-foot intervals along previously non-located FOPL segments. FOPLB85GB0102A, FOPLB85GB0102B, FOPLB85GB0102C, FOPLB85GB0103A, and FOPLB85GB0103B were advanced to define the lateral extent of soil and groundwater contamination detected during the 1999 investigation. Eleven soil samples were collected from the seven boring locations from 3 to 16.5 feet bgs; the sampling were submitted for analysis of TPH-diesel and TPH-motor-oil. Select samples were also analyzed for PCBs and/or PAHs. Four grab groundwater samples were collected from borings FOPLB85GB0102A, FOPLB85GB0102C, FOPLB85GB0103A, and FOPLB85GB0103B and submitted for analysis of TPH-diesel, TPH-motor-oil, and PAHs. TPH-type soil staining and odor were observed, and organic vapors were detected at boring FOPLB85GB0100 from

12 to 17 feet bgs during drilling operations. VOCs were detected with a PID at a concentration of 36 ppm at this depth interval. Hydrocarbon staining was also evident at the 9- to 12-foot-bgs depth interval at FOPLB85GB0102A.

4.7.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of soil and groundwater contamination have largely been defined by samples collected during previous investigations of the FOPL. Twenty-eight soil samples and four groundwater samples have been collected along this FOPL segment during previous investigations.

4.7.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons have been detected in soil at elevated concentrations in the vicinity of the FOPL segment H1/6/B85, as shown in Figure 3.8-1. Ten soil samples collected in the vicinity of the FOPL segment contained TPH compounds at concentrations exceeding Tier 1 ESLs. TPH-diesel and TPH-motor-oil were detected at maximum concentrations of 16,000 mg/kg and 10,000 mg/kg, respectively, in a sample collected from 3 feet bgs at B085HA003. Elevated concentrations of TPH-diesel and TPH-motor-oil were also detected in a sample collected at 3.2 feet bgs at B085HA004 (12,000 mg/kg and 8,100 mg/kg, respectively). Step-out soil samples collected around B085HA003 and B085HA004 at similar depths as these samples indicate that the source of the contaminated soil is laterally bound, as shown in Figure 3.8-1. Lower concentrations of these constituents were detected in samples collected at approximately 3 to 5 feet bgs and approximately 10 feet from these samples to the north (up to 3,500 mg/kg at B085HA005 and up to 610 mg/kg at B085GB008), east (nondetect at FOPLB85GB0102A), south (up to 1,100 mg/kg at B085GB005), and west (up to 680 mg/kg at B085HA006).

Moderate concentrations of TPH-diesel, TPH-fuel-oil, and TPH-motor-oil (up to 1,800 mg/kg) are present in some areas beneath Building 85 to approximately 9.5 feet bgs, as indicated by analytical results for samples collected from 8 to 9.5 feet bgs at B085GB005, B085GB006, and FOPLB85GB0102A. Contamination at this depth interval is laterally defined to the east (downgradient) by a sample collected at 9.5 feet bgs at FOPLB85GB0103A and vertically defined by a sample collected at 11 feet bgs at FOPLB85GB0102B. TPH-diesel and TPH-motor-oil were detected at concentrations below Tier 1 ESLs in these samples, which were collected in 2003.

Two soil samples collected from two boring locations (FOPLB85GB0100 and FOPLB85GB0102B) at 8 and 13 feet bgs were analyzed for PAHs (Figure 3.1-3). PAHs were not detected at concentrations exceeding the appropriate Tier 1 ESLs. Although benzo(a)anthracene and benzo(a)pyrene were detected above the Tier 1 ESLs designated for soil at depths less than 10 feet bgs, the elevated concentrations of these PAHs were detected in samples collected at 13 feet bgs. Therefore, the Tier 1 ESL designated for soil greater than 10 feet deep is an appropriate point of comparison. The Tier 1 ESLs for benzo(a)anthracene and benzo(a)pyrene at this depth interval are 12 mg/kg and 1.5 mg/kg, respectively (Table 1.4-2). Benzo(a)anthracene and benzo(a)pyrene were detected at maximum concentrations of 1.5 mg/kg and 0.56 mg/kg, respectively, in the sample collected from FOPLB85GB0100 at 13 feet bgs.

BTEX compounds analyzed from 16 soil samples collected in 1999 were not detected at concentrations above Tier 1 ESLs for soil in industrial areas (Figure 3.1-2). The sample submitted for analysis of PCBs (collected from 8 feet bgs at FOPLB85GB0102B) did not contain PCBs at concentrations exceeding analytical reporting limits.

A Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) to evaluate the potential risk from TPH-diesel, TPH-fuel-oil, TPH-motor-oil in shallow and deep soil. These analytes were detected at concentrations exceeding Tier 1 ESLs for industrial sites. The Tier 2 screening levels are provided in Table 1.4-3, and the methodology for deriving the Tier 2 screening levels at FOPL segment H1/6/B85 is provided in Appendix D. A statistical analysis of the TPH-diesel and TPH-motor-oil data for soil samples collected in shallow soil concluded that the EPC is approximately 4,700 mg/kg and 5,000 mg/kg, respectively. The EPCs for TPH-diesel and TPH-motor-oil remaining in surface soil at FOPL segment H1/6/B85 are below the Tier 2 screening level (10,000 mg/kg). The EPC is intended to represent an upper-bound average concentration that receptors would be exposed to at the site and is either the 95 percent UCL on the mean or the maximum observed concentration.

4.7.4.2 Nature and Extent of Groundwater Contamination

Four groundwater samples were collected along FOPL segment H1/6/B85 in 2003. TPH-diesel and TPH-motor-oil were detected above Tier 1 ESLs at maximum concentrations of 5,800 µg/L and 3,100 µg/L, respectively, in the grab groundwater sample collected from FOPLB85GB0103B. Elevated concentrations of these constituents were also detected in the remaining samples at concentrations ranging from 870 µg/L to 2,200 µg/L (Figure 3.8-1). Groundwater samples have not been collected east of these sample locations to define the lateral extent of groundwater contamination in the downgradient direction.

Each of the four grab groundwater samples collected downgradient of FOPL segment H1/6/B85 were analyzed for PAHs. Select PAHs were detected in the groundwater samples collected from FOPLB85GB0102A and FOPLB85GB0103A. PAHs were not detected at concentrations exceeding the corresponding Tier 1 ESL (Figure 3.1-3).

A Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) to evaluate the potential risk from TPH-diesel and TPH-motor-oil in groundwater. These analytes were detected at concentrations exceeding the Tier 1 ESL. The site-specific Tier 2 screening level for these analytes 50,000 µg/L (Table 1.4-4), and the methodology for deriving the Tier 2 screening levels at FOPL segment H1/6/B85 is provided in Appendix D. Residual concentrations of petroleum hydrocarbons remaining in groundwater at FOPL segment H1/6/B85 are significantly below this Tier 2 screening level.

4.7.5 Conclusions and Recommendations for Further Investigative and/or Remedial Action

FOPL segment H1/6/B85 has been adequately characterized. Twenty-eight soil samples were collected from 17 locations along this 305-foot span of FOPL between 1999 and 2003. A Tier 2 risk analysis was performed for the FOPL segment due to elevated TPH-diesel, TPH-fuel-oil, and TPH-motor-oil concentrations detected in surface and/or subsurface soil and elevated TPH-diesel and TPH-motor-oil concentrations detected in groundwater. The

EPCs for all COPCs were below the corresponding Tier 2 screening level (Tables 1.4-3 and 1.4-4). These results indicate that previous releases from FOPL segment H1/6/B85 have not resulted in conditions that pose a significant risk to human health or the environment.

Although the extent of groundwater contamination is not defined in the downgradient direction, the source of contamination (FOPL segment H1/6/B85) is more than 250 feet from the Strait. Because of the immobility and highly biodegradable nature of TPH and related compounds, an impact to surface water from sites located more than 250 feet from a surface-water body is not likely to occur (Section 1.4.2). Therefore, previous releases of petroleum hydrocarbons from FOPL segment H1/6/B85 are not expected to result in a discharge of constituents to Mare Island Strait.

The southern end of FOPL segment H1/6/B85 was located during trenching operations performed during 2003. Therefore, the source of potential soil and groundwater contamination remains in place and should be remediated. Two ends of FOPL segment H1/6/B85 will be exposed through trenching, and the pipeline will be cut (if necessary) using cold-tapping procedures and drained (if necessary). The trenches likely will be advanced immediately south of Building 85 (at the location of the 2003 exploratory trench) and near the northern wall of Building 85. A vacuum will then be applied to the segment. If the pipeline successfully holds a vacuum of 5 inches mercury for 30 minutes with less than a 10 percent deviation in the vacuum, the pipeline will be considered to be absent of fractures and will subsequently be flushed and sealed with concrete caps. If a vacuum cannot be maintained, pressure testing may be performed to isolate the point of fracture. However, further investigative or remedial action will be based on pipeline conditions encountered in the field and will be performed in collaboration with regulatory agencies. Additionally, if the pipeline is found to continue further north into Building 271, an additional trench will be advanced near the northern end of FOPL segment H1/6/B85, and an additional vacuum test will be performed.

4.8 FOPL Segment H1/2/B89

4.8.1 Site Description

FOPL segment H1/2/B89 is located in an area of IA C1 with proposed mixed (industrial) land use (Figure 2.2-2). FOPL segment H1/2/B89 is approximately 310 feet long. FOPL segment H1/2/B89 has a 2-inch diameter and is part of a network of piping extending beneath Buildings 85, 271, 89, and 91, as shown in Figure 2.4-1. FOPL segment H1/2/B89 connects with FOPL segment H1/6/B85 at its western end and extends east beneath and south of Buildings 89 and 91. Buildings 89 and 91 were constructed in 1871 and were used as storage for the boiler shop (CH2M HILL 2002e).

The eastern end of this FOPL segment is located approximately 120 feet away from Mare Island Strait. Groundwater at the site flows to the northeast towards Mare Island Strait (Figure 2.5-1). This FOPL segment is located in an area with a surface elevation of 13 to 16 feet above msl. The majority of this FOPL segment is located in soil composed of fill material.

4.8.2 Previous Actions and Investigations

A field investigation was performed along FOPL segment H1/2/B89 during 1996 and 1997, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). A subsurface survey using GPR was performed in an attempt to locate FOPL segment H1/2/B89. Several subsurface utilities in the vicinity of the suspected location of this FOPL were identified, but the presence of this FOPL segment was not confirmed.

4.8.3 2002-2003 FOPL Investigation

In accordance with the field approach presented in the final SAP for the FOPL (CH2M HILL 2003a), further investigation and site characterization of FOPL segment H1/2/B89 were required following the previous investigation. In October 2002, a geophysical investigation was performed in an attempt to locate the eastern end of FOPL segment H1/2/B89 using GPR and metal-detection equipment. The results of the GPR survey are presented on Plate 44 in Appendix C. The FOPL was not located during this investigation. These data suggest that this pipeline segment is no longer present or never existed.

An exploratory trench was advanced at the southern end of the suspected location of FOPL segment H1/2/B89 during June 2003 to 12 feet bgs to confirm the results of the geophysical survey. The trench was approximately 13.5 feet long and 4 feet wide and was positioned perpendicular to the orientation of the FOPL. The FOPL segment was not identified, nor was there any visual evidence of petroleum hydrocarbon contamination, during trenching operations. This indicates that the FOPL is no longer present at this location. Two soil samples were collected from the trench at 5 feet and 12 feet bgs and submitted for TPH-diesel and TPH-motor-oil analysis. The sample location of these samples is presented as FOPLB89SS0100 in Figure 3.8-1.

During June 2003, two borings (FOPLB89GB0100 and FOPLB89GB0101) were advanced at approximately 100-foot intervals to confirm that potential releases from this former FOPL segment did not result in significant concentrations of petroleum hydrocarbons in the surrounding soil. Four additional borings (FOPLB89GB0100A, FOPLB89GB0100B, FOPLB89GB0100C, and FOPLB89GB0101A) were advanced in July and October 2003 to delineate the lateral and vertical extents of elevated TPH-diesel and TPH-motor-oil concentrations detected in soil samples collected at FOPLB89GB0100 and FOPLB89GB0101 in June 2003. Ten soil samples were collected from the six borings from 5 to 14.5 feet bgs and submitted for analysis of TPH-diesel, TPH-motor-oil, and, in some cases, PCBs and PAHs. Four grab groundwater samples were collected from borings FOPLB89GB0100A, FOPLB89GB0100C, FOPLB89GB0101, and FOPLB89GB0101A and submitted for analysis of TPH-diesel, TPH-motor-oil, and PAHs.

Hydrocarbon staining and odor were observed during drilling at FOPLB89GB0100 (at 10 to 13 feet bgs) and at FOPLB89GB0100C (at 9 to 13 feet bgs) during drilling operations. Organic vapors were detected with a PID at FOPLB89GB0100 and FOPLB89GB0100C at these depth intervals at maximum concentrations of 12.8 ppm and 12.4 ppm, respectively. In addition, separate-phase hydrocarbons were observed on the groundwater surface in the temporary well set at FOPLB89GB0100C at 7 feet bgs. Observations made during drilling operations are documented in the lithologic logs presented in Appendix B.

4.8.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of soil and groundwater contamination generally has been defined by samples collected during the 2002-2003 FOPL investigation. Ten soil and four grab groundwater samples have been collected along this FOPL segment.

4.8.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons were detected in soil at elevated concentrations in the vicinity of the FOPL segment H1/2/B89, as shown in Figure 3.8-1. Three soil samples contained petroleum hydrocarbon compounds at concentrations exceeding Tier 1 ESLs. TPH-diesel was detected at a maximum concentration of 9,400 mg/kg in a sample collected from FOPLB89GB0100C at 9 feet bgs in October 2003. TPH-motor-oil was detected at a maximum concentration of 2,200 mg/kg from FOPLB89GB0100A at 9 feet bgs in July 2003. The vertical and lateral extents of contamination at these locations are defined by samples collected deeper than the original sample depth and up and downgradient of these samples (Figure 3.8-1). Soil samples collected the closest to Mare Island Strait did not contain elevated concentrations of petroleum hydrocarbons.

Select PAHs were detected in soil samples collected along the FOPL segment (Figure 3.1-3). The only PAH compound detected at a concentration exceeding the corresponding Tier 1 ESL was benzo(a)pyrene at 0.34 mg/kg. The Tier 1 ESL for this compound is 0.13 mg/kg (Table 1.4-2). The sample submitted for analysis of PCBs (collected at 9 feet bgs at FOPLB89GB0100B) did not contain PCBs at concentrations exceeding analytical reporting limits.

A Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) to evaluate the potential risk from TPH-diesel, TPH-motor-oil, and benzo(a)pyrene in soil. These analytes were detected at concentrations exceeding the Tier 1 ESLs for industrial sites. The Tier 2 screening levels for these COPCs are provided in Table 1.4-3, and the methodology for deriving the Tier 2 screening levels at FOPL segment H1/2/B89 is provided in Appendix D. All COPCs were detected at concentrations below the corresponding Tier 2 screening level.

4.8.4.2 Nature and Extent of Groundwater Contamination

Four groundwater samples collected in 2003 along the FOPL segment contained TPH-diesel and/or TPH-motor-oil at concentrations exceeding Tier 1 ESLs. TPH-diesel and TPH-motor-oil were detected at maximum concentrations of 51,000 and 31,000 µg/L, respectively, in a grab groundwater sample collected from FOPLB89GB0100C in 2003. This sample contained separate-phase hydrocarbons, as presented in Section 4.8.3. The separate-phase hydrocarbons are likely present as a result of previous releases from former FOPL segment H1/2/B89. Significantly lower concentrations of petroleum hydrocarbons were detected in grab groundwater samples collected upgradient and downgradient of this sample. FOPLB89GB0100A is located 15 feet upgradient of FOPLB89GB0100C, and FOPLB89GB0101 and FOPLB89GB0101A are located approximately 75 and 90 feet downgradient of FOPLB89GB0100C, respectively. These results suggest that the lateral extent of separate-phase hydrocarbons are defined in the downgradient direction.

Chrysene is the only PAH detected in groundwater at concentrations above Tier 1 ESLs. Chrysene was detected at a concentration of 0.62 µg/L from FOPLB89GB0100C in 2003 (Figure 3.1-3). The groundwater samples collected downgradient of this sample did not contain chrysene at concentrations exceeding analytical reporting limits.

A Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) to evaluate the potential risk from TPH-diesel, TPH-motor-oil, and chrysene in groundwater. These analytes were detected at concentrations exceeding the Tier 1 ESLs. The Tier 2 screening levels for these COPCs are provided in Table 1.4-4, and the methodology for deriving the Tier 2 screening levels at FOPL segment H1/2/B89 is provided in Appendix D. The site-specific Tier 2 screening level for TPH-diesel, TPH-motor-oil, and chrysene in groundwater at FOPL segment H1/2/B89 have been determined to be 50,000 µg/L. Although TPH-motor-oil and chrysene were detected at concentrations below this value, residual concentrations of TPH-diesel remaining in groundwater at FOPL segment H1/2/B89 are above the Tier 2 screening level. An interim remedial action is warranted for this site, as described in Section 4.8.5.

Degradation of Groundwater Assessment. Although groundwater has not been sampled downgradient of FOPL segment H1/2/B89, groundwater samples collected along this FOPL segment (as close as 220 feet from the Strait) indicate a release of petroleum hydrocarbons has occurred to groundwater that may result in an impact to Mare Island Strait. The EPCs for TPH-diesel and TPH-motor-oil in groundwater exceed the appropriate water quality objective for identifying sources that potentially degrade groundwater or surface water (the chronic toxicity level for marine aquatic environments). Further, the eastern end of FOPL segment H1/2/B89 is located approximately 120 feet from Mare Island Strait, indicating that groundwater contamination associated with previous releases from this FOPL segment may not degrade or stabilize before migrating to the Strait.

Based on the results of the 2002-2003 FOPL investigation, the FOPL segment is determined to no longer be present, indicating that the primary source of TPH-diesel and TPH-motor-oil contamination in groundwater has been removed. However, the fact that separate-phase hydrocarbons were observed in a grab groundwater sample collected at FOPLB89GB0100C suggests that a secondary source of soil and groundwater contamination remains at the site. Additional data are required to determine if petroleum hydrocarbons detected in groundwater more than 200 feet from the Strait are migrating downgradient towards the Strait. Therefore, installation of two groundwater monitoring wells and subsequent quarterly monitoring is proposed, as presented in Section 4.8.5. Data collected during quarterly monitoring will be used to determine if natural attenuation of petroleum hydrocarbons is occurring in groundwater at this site and if elevated concentrations of petroleum hydrocarbons are migrating towards the Strait. If the monitoring data indicate that elevated concentrations of petroleum hydrocarbons remain in groundwater, an evaluation will be performed following groundwater monitoring to determine the most technologically and economically feasible remedial alternative for the groundwater.

4.8.5 Conclusions and Recommendations for Further Investigative and/or Remedial Action

FOPL segment H1/2/B89 was not located during the geophysical survey and exploratory trenching performed in 2003. These data suggest that this FOPL segment is no longer

present or never existed. However, sampling conducted in 2003 indicates the presence of elevated concentrations of TPH in soil and groundwater at the site. A Tier 2 risk analysis was consequently performed to evaluate the potential risk from TPH-diesel, TPH-motor-oil, and benzo(a)pyrene in soil and TPH-diesel, TPH-motor-oil, and chrysene in groundwater. These analytes were detected in samples collected along the segment at concentrations exceeding Tier 1 ESLs. The Tier 2 screening levels for these analytes in soil and groundwater are presented in Tables 1.4-3 and 1.4-4, respectively. The EPC for TPH-diesel in groundwater is greater than the Tier 2 screening level for this analyte (50,000 µg/L). Specifically, an elevated concentration of TPH-diesel was detected in a grab groundwater sample collected at FOPLB89GB0100C in 2003. Separate-phase hydrocarbons were observed in this sample at the time of collection, suggesting that a secondary source of soil and groundwater contamination remains at the site.

To address the elevated petroleum hydrocarbon concentrations detected in groundwater, two monitoring wells will be installed and sampled on a quarterly basis. One monitoring well will be installed at previous sample location FOPLB89GB0100C to determine if the petroleum hydrocarbon concentrations detected in the grab groundwater sample at this location are representative of conditions in the aquifer, or if the concentrations are biased high due to the presence of particulate matter in the sample. The second monitoring well will be installed at the eastern end of FOPL segment to confirm that groundwater discharging to the Strait downgradient of this FOPL segment does not contain elevated concentrations of petroleum hydrocarbons. The proposed monitoring well locations are presented in Figure 4.1-1. Quarterly monitoring will commence with the April 2004 monitoring event and will continue for a minimum of four consecutive quarters. Groundwater samples collected from these wells will also be analyzed for natural attenuation parameters to determine if petroleum hydrocarbons in groundwater (if detected) are degrading over time through natural attenuation. The results of this monitoring will be documented in the Implementation Report for FOPL segments in IA C1. If quarterly monitoring indicates TPH-diesel and TPH-motor-oil concentrations below the chronic toxicity level for marine aquatic environments, then the Implementation Report will conclude that aquatic life and the Mare Island Strait are adequately protected. If groundwater monitoring data indicate elevated concentrations of petroleum hydrocarbons at the Strait, an evaluation will be performed to determine the most technologically and economically feasible remedial alternative for groundwater.

4.9 FOPL Segment I1/1.5/B289

4.9.1 Site Description

FOPL segment I1/1.5/B289 has 1.5-inch diameter and is suspected to be located northwest of Building 289 in IA C1, as shown in Figure 2.4-1. The FOPL is not depicted as entering Building 289 on historical Navy maps. It is located in an area with a proposed mixed (industrial) land use (Figure 2.2-2). The FOPL segment is approximately 74 feet long and is suspected of being present at approximately 4 feet bgs. The FOPL segment is buried in soil composed of fill material. This FOPL segment is located in an area with a surface elevation of 9 to 10 feet above msl. Groundwater at the site is located at approximately 6 to 8 feet bgs

and flows to the northeast (Figure 2.5-1). The FOPL segment is located approximately 330 feet away from Mare Island Strait.

4.9.2 Previous Actions and Investigations

No attempt has been made to locate this pipeline during previous investigations. In addition, no samples have been collected in the vicinity of this segment during previous investigations of other sites. FOPL segment I1/1.5/B289 was identified during a CH2MHILL review of internal Navy documents in 2002.

4.9.3 2002-2003 FOPL Investigation

A geophysical survey was performed in October 2002 to locate FOPL segment I1/1.5/B289 using GPR and metal-detection equipment. The results of this survey are presented on Plate 21 of Appendix C. An unidentified subsurface utility suspected of being the FOPL was located during the survey. Consequently, an exploratory trench was advanced at a location parallel to and east of Wiseman Avenue and approximately 2 feet west of the northwest corner of Building 289 in October 2003 (to expose both “legs” of the FOPL) to determine if the FOPL is present. The approximate location of the exploratory trench is presented in Figure 3.19-1. The trench was advanced for a distance of approximately 20 and 9 feet bgs. Numerous utilities were exposed during trenching operations. Pipelines suspected of being the FOPL (due to the orientation and size of the pipelines) were encountered at approximately 4 feet bgs.

In addition to performing exploratory trenching, two direct-push borings (FOPLB289GB0100 and FOPLB289GB0101) were advanced along the suspected location of the FOPL segment in June 2003. The borings were advanced to 12 feet bgs. Soil samples were collected at 5 and 12 feet bgs and submitted for analysis of TPH-diesel and TPH-motor-oil. No unusual odors or staining were recorded during drilling.

4.9.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of petroleum hydrocarbon contamination in soil in the vicinity of FOPL segment I1/1.5/B289 was defined by sampling efforts performed during recent investigations of the FOPL. Four soil samples have been collected along this 74-foot segment. Soil samples have not been analyzed for PAHs or BTEX compounds. No groundwater samples have been collected along this FOPL segment.

4.9.4.1 Nature and Extent of Soil Contamination

Petroleum hydrocarbons have not been detected at concentrations exceeding analytical reporting limits in the four samples collected along this FOPL segment, as presented in Figure 3.19-1.

4.9.5 Conclusions and Recommendations for Further Investigative and/or Remedial Action

Although petroleum hydrocarbons have not been detected in soil samples collected along FOPL segment I1/1.5/B289, the results of exploratory trenching performed during October 2003 suggest that FOPL segment I1/1.5/B289 may still be present. Consequently, the utility suspected of being the FOPL will be exposed, and an attempt will be made to apply a

vacuum to this segment. Two ends of the FOPL segment will be exposed through trenching, and the pipeline will be cut (if necessary) using cold-tapping procedures and drained (if necessary). A vacuum will then be applied to the segment. If the pipeline successfully holds a vacuum of 5 inches mercury for 30 minutes with less than a 10 percent deviation in the vacuum, the pipeline will be considered to be absent of fractures and will subsequently be flushed and sealed with concrete caps. If a vacuum cannot be maintained, the pipeline will likely be removed due to the size, length, and shallow depth at which the utility is located. However, further investigative or remedial action will be based on pipeline conditions encountered in the field and will be performed in collaboration with regulatory agencies.

4.10 FOPL Segments I1/6/B473A&B, I1/6/B693A&B, and I1/4/B471

4.10.1 Site Description

FOPL segments I1/4/B471, I1/6/B473A&B, and I1/6/B693A&B are located within the boundaries of IR03 in IA C1. These FOPL segments were part of the fuel distribution system that supported the transport of fuel oil between four 19,200-gallon concrete USTs (UST693-D7, -D8, -D9, and -D10) at Building 693 and Berths 3 and 4. The USTs and associated FOPL segments in this area have been identified as one of the sources of contamination at IRP site IR03. USTs 693-D7 through -D10 are discussed in detail, and recommended for closure in the *Investigation Area C1 UST Site Characterization Report* (CH2MHILL 2003g). Other areas in IR03, associated with non-source areas and IR14, will be addressed in the IA C1 remedial investigation report to be submitted in 2004.

IR03 was first developed in the 1920s as a submarine repair base. The facility was expanded, and a portion of the fuel facility between Nimitz Avenue and Berth 3 was constructed in the 1930s. Expansion continued in the 1940s, and the remainder of the fueling facility was constructed at that time. The submarine repair facility was moved from the site in the 1950s, but the fuel facility continued to operate as the main refueling facility for the shipyard until 1994. The tanks and fuel lines were known to have contained only fuels and were filled from commercial tanker trucks. The fuel facility suspended operations on February 7, 1994.

FOPL segment I1/4/B471 consists of two pipelines that are 4 inches in diameter (supply and return pipelines) and extend from FOPL segment I1/4/BE3BE8 at Berth 4 to the pump house at Building 471. This FOPL segment is 128 feet long. Portions of FOPL segment I1/6/B473A&B are located aboveground and connect the ASTs near Building 515 to FOPL segment I1/4/B471. The remaining portions of the FOPL segment (102 feet) extend west of the ASTs below ground. FOPL segment I1/6/B473A&B has a 6-inch diameter. FOPL segment I1/6/B693A&B has a 6-inch diameter and connects the pump house at Building 693 to FOPL segment I1/6/B473A&B.

The thickness of artificial fill across the site varies from 1.5 to 16 feet and increases substantially in the immediate vicinity of Mare Island Strait. The fill material is underlain by clay-to-clayey silt (Younger Bay Mud) with zones of sand, shells, and peat (TtEMI and U&A 1998). Bedrock underlies the Younger Bay Mud at approximately 40 feet bgs. Depths to groundwater range from 3 to 11 feet bgs. The groundwater flow direction in the vicinity of IR03 is generally northeast, towards Mare Island Strait (Figure 2.5-1). Tidal influence

studies showed substantial tidal effects (about 2 feet of groundwater level variation) in wells located within 50 feet of Mare Island Strait (TtEMI and U&A 1998). The topography of IR03 is generally flat, with elevations of about 8 to 10 feet above msl.

4.10.2 Previous Actions and Investigations

FOPL segments I1/4/B471, I1/6/B473A&B, and I1/6/B693A&B are located within the boundaries of IR03, and select IR03 investigations are applicable to these FOPL segments. Separate-phase hydrocarbons have been detected at the site and likely are associated with previous releases from the FOPL. A summary of the actions specifically related to the separate-phase hydrocarbons is presented in Section 4.10.2.1.

Investigations at IR03 began in 1983 with an initial assessment study, and the site was characterized as being contaminated by petroleum-related compounds (Ecology and Environment 1983). This study concluded that groundwater in and around IR03 was contaminated by fuel oil and identified the USTs and the fuel distribution system as the most probable source of contamination. The initial assessment study also indicated that contamination of the stormwater pipelines and open trenches by unknown oily substances was observed during the refueling facility's operating life.

The characterization of IR03 continued in 1987 when one soil sample and one groundwater sample were collected from each of 20 boring locations as part of a verification study. Fifteen of the borings were completed as monitoring wells (03W05-03W19). The soil and groundwater samples were submitted for VOCs, SVOCs, PCBs, and oil and grease analyses (Richesin/SCS 1987).

A Phase I remedial investigation was performed from 1990 to 1992 and included: (1) a GPR survey to define the geometry of subsurface structures; (2) a soil gas survey to assess the distribution of petroleum hydrocarbon contamination in the soil; (3) slug tests of three wells to estimate the hydraulic conductivity of the unconfined aquifer on site; and (4) a study of tidal influence upon the local groundwater level, gradient, and direction (IT 1992). The results of the soil gas survey led to the drilling of 10 new soil borings, four of which were completed as monitoring wells (03W01 through 03W04).

PRC conducted quarterly groundwater sampling of existing monitoring wells across the former MINS from 1992 through 1994 (PRC 1996c). Groundwater results from nine monitoring wells in IR03 are applicable to the areas near FOPL segments I1/4/B471, I1/6/B473A&B, and I1/6/B693A&B. PRC conducted a Phase II remedial investigation from 1994 to 1996 (PRC 1996c). This phase included: (1) vacuum excavation sampling; (2) sampling using a direct-push rig; (3) fuel fingerprinting (chemical assay of the separate-phase hydrocarbons present in well 03W13); (4) piezometer installation; (5) aquifer testing; and (6) a tidal influence study. Four new piezometers were installed in former borings. TPH-gasoline and TPH-diesel were detected throughout the site, with the highest concentrations often found in samples from near the four 19,200-gallon USTs (Building 693), near the six ASTs that stored diesel fuel Northwest of Building 471, and near Industrial Wastewater Pump Station No. 4. Results of the remedial investigation and the quarterly groundwater monitoring program indicated that the migration of separate-phase hydrocarbons may be impeded toward the Strait by the quay wall, and that the separate-

phase hydrocarbons may be migrating to the northwest, parallel to the shoreline (PRC 1996c).

Former USTs 693-D7, -D8, -D9, and -D10 were marked as “out of compliance” in 1995 (DoD 1995). The USTs and the associated pumphouse (Building 693) and FOPL segment I1/6/B693A&B (consisting of two 6-inch supply and return pipelines) were excavated between September 26, 1996, and August 12, 1997, in accordance with the *Closure Plan for Underground Storage Tanks 693 Mare Island Naval Shipyard* (SSPORTS 1996d). Sixty-four feet of the parallel supply and return pipelines comprising FOPL segment I1/6/B693A&B were flushed (following vacuum testing) and left in place to avoid disturbance to railroad tracks. Following excavation, thin layers of separate-phase hydrocarbons were observed in some areas in the immediate vicinity of Building 693. The hydrocarbons were removed using sorbent material. Traditional confirmation soil sampling was not performed at UST Site 693 and the associated FOPL segment after the excavation. The excavation area was backfilled to within 2 feet of the surface with “slightly petroleum contaminated soil” from UST 772 (IR23) and capped with original overburden (SSPORTS 1998). One cubic yard of ABM was observed during removal of the FOPL segment near Building 923 (Weston 2001).

A field investigation was performed along FOPL segment I1/4/B471 as part of the island-wide investigation of the FOPL performed during 1996 through 1999, as documented in the *Draft Removal Summary Report for Fuel Oil Pipelines* (Weston 2001). The entire length of this FOPL segment, which consists of two pipelines, was vacuum tested and flushed. The portion of FOPL segment I1/6/B473A&B extending west of the ASTs could not be located during this investigation. The portion of this FOPL segment extending aboveground between the ASTs and Building 471 was previously flushed when the ASTs were closed.

Further sampling was performed at IR03 in 2002 and consisted of the collection of soil samples from 34 borings (IR03GB0100 through IR03GB0133) and the collection of 42 groundwater samples from 21 borings and 21 monitoring wells. Soil and groundwater samples generally were analyzed for TPH-gasoline, TPH-diesel, TPH-motor-oil, VOCs, and PAHs to improve understanding of the conceptual site model and to support the human health and ecological risk assessments. The field activities were performed consistent with the *Draft Sampling and Analysis Plan for Investigation Area C1* (CH2M HILL 2002f). Only soil samples collected from seven boring locations (IR03GB0108, IR03GB0114, IR03GB0115, IR03GB0116, IR03GB0118, IR14GB0104, IR03MW0100, and IR03MW0102) advanced during this investigation are applicable to the FOPL segments I1/4/B471, I1/6/B473A&B, and I1/6/B693A&B. Groundwater samples were also collected from borings IR03GB0108, IR03GB0114, IR03GB0115, IR03GB0116, IR03GB0118, IR14GB0104, IR03MW0100, and IR03MW0102. Strong hydrocarbon odors were noted in IR03GB0108 (from 2 to 16 feet bgs), IR03GB0115 (from 2.5 to 10 feet bgs), and IR03MW0100 (1.5 to 5 feet bgs) during this investigation. A slight organic odor was noted at 7 feet bgs in IR14GB0104 and at 15 feet bgs in IR03MW0102.

Groundwater samples have been collected and analyzed from 10 monitoring wells (03W08, 03W09, 03W12, 03W13, 03W15, 03W16, 03W18, 03W19, IR03MW0100, IR03MW0102) for TPH (diesel, motor oil, and gasoline), PAHs, BTEX compounds, and natural attenuation parameters semi-annually to quarterly from July 2002 through August 2003.

4.10.2.1 Separate-phase Hydrocarbons in IR03

Separate-phase hydrocarbons have been detected in monitoring wells 03W08, 03W13, and 03W16 and in temporary piezometers located at boring locations IR03GB050 and IR03GB051. In 1994, MINS manually extracted separate-phase hydrocarbons from wells 03W13 and 03W16. In November 1995, MINS installed automatic product skimmers in both of these wells. The automatic product skimmers were ineffective due to the extremely slow product infiltration rates (30 minutes to 24 hours for product recharge) into the monitoring wells and were shut down in March 1996. The separate-phase hydrocarbons were then removed manually on a weekly basis (Navy 1996). The total volume of hydrocarbons extracted from all wells and piezometers from November 1994 through July 1997 in IR03 totals approximately 100 gallons (SSPORTS 1997).

Four trenches were excavated at locations presented in Figure 3.19-1 to better characterize the extent of the separate-phase hydrocarbons present in the subsurface. Excavation was intended to reach approximately 10 feet bgs but was actually stopped at about 7.5 feet bgs when a buried relief platform was encountered. No visible signs of separate-phase hydrocarbons were noted in the soil removed from the trenches, but petroleum-type odor was evident. These results indicate that separate-phase hydrocarbons are entering the wells at an elevation below the relief platform (SSPORTS 1997). The absence of separate-phase hydrocarbons in the test trenches indicates that the source(s) and flow path(s) of hydrocarbons to the IR03 wells and piezometers have yet to be determined; however, it is possible the hydrocarbons may have come from a leak in FOPL segment I1/4/B471. Hydrocarbons may have migrated within the backfill of the intersecting stormwater pipeline utility corridor (Figure 3.19-1).

The monitoring wells and piezometers containing separate-phase hydrocarbons continued to be monitored, but the minimal recoverable amount of separate-phase hydrocarbons in the wells prompted SSPORTS to suspend recovery efforts by September 1998 (Navy 1998). Additional trenching activities were proposed for the site but were not performed.

CH2M HILL resumed hydrocarbon recovery efforts in monitoring wells 03W08, 03W13, and 03W16 as of January 2003 by testing the effectiveness of using oil-adsorbent socks. Piezometers 03GB050 and 03GB051 were not accessible because the borings had been backfilled. At the time of oil-adsorbent sock installation, the thickness of separate-phase hydrocarbons in the wells was 1.6 feet in 03W13, 0.4 foot in 03W16, and less than 0.05 inch in 03W08. The socks were changed out up to three times in each well during the test period. Three gallons of product were removed by day 50 (mid-February 2003) from wells 03W13 and 03W16. The very thin layer of separate-phase hydrocarbons in well 03W08 was not noticeably recoverable. After the initial product removal from these wells, the yield of separate-phase hydrocarbons from the formation was extremely slow. The socks were removed from the wells in mid-February in order to collect groundwater samples and were not reinserted. On December 19, 2003 product layers were 0.43 foot in 03W16 and 0.52 foot in 03W13. The socks were reinstalled in the three wells in March 2004.

4.10.3 2002-2003 FOPL Investigation

A geophysical survey using metal-detecting equipment was performed in October 2002 in an attempt to identify and locate FOPL segment I1/6/B473A&B. The survey was performed adjacent to Building 923 in an area where the FOPL reportedly connects to former FOPL

segment I1/6/B693A&B. The results of this survey are presented on Plate 22 of Appendix C. Subsurface utilities that were suspected of being FOPL segment I1/6/B473A&B were identified at two of the three GPR traverses. Consequently, these areas were investigated further, as presented below.

One exploratory trench (4 feet wide by 15 feet long) was advanced at a location between Building 923 and Building 289, 5 feet southwest of Building 923 and parallel to Building 923 (running north-south along the long axis). The trench location is presented as FOPLB473A&BSS0100 in Figure 3.19-1. This trench was excavated to 7 feet bgs in an attempt to locate FOPL segment I1/6/B473A&B. Pipelines 4 and 6 inches in diameter were identified at approximately 5 feet bgs in the trench, oriented northwest-southeast, diagonally, through the southwest corner of the trench. The 6-inch-diameter pipeline is suspected of being the FOPL because the pipeline has an orientation similar to the suspected orientation of FOPL segment I1/6/B473A&B. Additionally, the soil adjacent to the pipeline appeared stained, and a strong hydrocarbon odor was noted. Two soil samples were collected: one beneath the suspected FOPL (5.5 feet bgs) and one 9 feet bgs to the north of the suspected FOPL for vertical delineation of potential contamination. The pipeline identified at this location will be investigated further as part of an interim remedial action (see Section 4.10.5).

Soil samples were collected from four direct-push borings (FOPLB471GB0100, FOPLB473A&BGB0100, FOPLB473A&BGB0101, and FOPLB693A&BGB0100) to satisfy the requirement that soil samples be collected at intervals of approximately 100 feet at removed and non-located FOPL segments and at intervals of approximately 200 feet at previously flushed FOPL segments. Soil samples were collected from 2 to 12 feet bgs. These samples were collected in accordance with the *Final Sampling and Analysis Plan for the Fuel-oil Pipeline* (CH2M HILL 2003a).

A hydrocarbon-type odor and black staining was noted at FOPLB473A&BGB0100 from 3.5 to 10 feet bgs (with PID readings from 1.5 to 30 ppm). A strong organic odor with PID readings from 65 to 241 ppm was noted from 2 feet to 6.5 feet bgs in FOPLB471GB0100. Refusal was encountered at 7.5 feet bgs at this location due to a suspected railroad timber. No other unusual visual or olfactory observations or PID readings were made during drilling operations for this site.

4.10.4 Nature and Extent of Soil and Groundwater Contamination

The nature and extent of TPH, BTEX, and PAH contamination in the vicinity of FOPL segments I1/4/B471, I1/6/B473A&B, and I1/6/B693A&B were defined by sampling efforts performed during previous investigations of the FOPL and more recent sampling (described in Sections 4.10.2 and 4.10.3). Soil and groundwater sample locations and results are presented in Figures 3.1-2, 3.1-3, and 3.18-1.

4.10.4.1 Nature and Extent of Soil Contamination

TPH-diesel was detected at elevated concentrations near FOPL segments I1/4/B471, I1/6/B473A&B, and I1/6/B693A&B in samples collected between 1993 and 2003. Figure 3.19-1 shows the distribution of the petroleum hydrocarbon concentrations in soil. TPH-diesel was detected in 35 of 94 soil samples, with 17 of these samples having elevated TPH-diesel results. TPH-diesel was detected at elevated concentrations (above Tier 1 ESLs)

in samples collected adjacent to FOPL segments I1/6/B473A&B and I1/6/B693A&B and in the area parallel to the Strait that contains separate-phase hydrocarbons (near the stormwater pipeline utility corridor). TPH-diesel was detected at a maximum concentration of 16,000 mg/kg at IR03GB017 (collected in 1993 at 5 feet bgs). The highest TPH-diesel concentrations were detected in samples collected in 1993 and 1994. More recent soil samples have a maximum TPH-diesel concentration of 4,000 mg/kg (collected from FOPLB473A&BSS0100 at 5.5 feet bgs in 2003). The TPH-diesel contamination is bounded by 59 nondetect sample locations between ground surface and 17 feet bgs.

TPH-motor-oil has not been detected in soil at concentrations exceeding the Tier 1 ESL (1,000 mg/kg). TPH-gasoline has been detected at a maximum concentration of 1,000 mg/kg (IR03GB017 at 5 feet bgs in 1993). However, samples collected since 2002 contained TPH-gasoline at concentrations of 4.4 mg/kg or lower.

BTEX compounds were not detected at elevated concentrations in samples associated with FOPL segments I1/4/B471, I1/6/B473A&B, and I1/6/B693A&B. Analytical results for samples analyzed for BTEX compounds are shown in Figure 3.1-2. Ethylbenzene and xylenes have been detected at the site at maximum concentrations of 0.14 mg/kg and 0.78 mg/kg, respectively, from a sample collected in 1994 (IR03GB050 at 8 feet bgs). Samples collected since 1994 did not contain BTEX compounds at concentrations exceeding analytical reporting limits.

Some PAH compounds were detected at elevated concentrations in at least one sample associated with FOPL segments I1/4/B471, I1/6/B473A&B, and I1/6/B693A&B. Analytical results for samples analyzed for PAHs are presented in Figure 3.1-3. For the 0- to 10-foot-bgs depth interval ("shallow soil"), benzo(a)pyrene is the only PAH to be detected at a concentration exceeding the Tier 1 ESL. Benzo(a)pyrene was detected at a maximum concentration of 0.75 mg/kg from a sample collected at 4.5 feet bgs from IR03GB0108 in 2002. This sample was collected near the former location of the USTs. The remaining samples collected from shallow soil, and analyzed for PAHs did not contain benzo(a)pyrene at elevated concentrations.

Benzo(a)pyrene, dibenz(a,h)anthracene, and naphthalene were detected at elevated concentrations in samples collected at depths greater than 10 feet. Tier 1 ESLs for soil less than 10 feet therefore are not an appropriate point of comparison; the Tier 1 ESLs for soil greater than 10 feet should be used. These values are 1.5 mg/kg, 4.3 mg/kg, and 4.8 mg/kg for benzo(a)pyrene, dibenz(a,h)anthracene, and naphthalene, respectively. The maximum detected concentrations in soil greater than 10 feet bgs for each of these compounds is 0.56 mg/kg, 0.61 mg/kg, and 11 mg/kg, respectively. Therefore, of all PAHs, only naphthalene is present in soil greater than 10 feet bgs at a concentration exceeding the Tier 1 ESL. Areas of elevated naphthalene concentrations are bound by no less than 36 nondetect sample locations with samples up to 15 feet bgs.

A Tier 2 risk analysis (outlined in Appendix D) was performed to determine whether each COPC for soil (TPH-diesel, TPH-gasoline, benzo(a)pyrene, and naphthalene) contributes significant human health or ecological risk for the site. Only compounds associated with FOPL contamination were evaluated for this Tier 2 analysis (TPH and PAH). All other constituents (VOCs, metals, pesticides, PCBs) are evaluated as part of the IR03 risk assessment presented in the IA C1 remedial investigation report to be submitted in 2004. The EPC

for each COPC is presented below the corresponding Tier 2 screening level, as presented in Table 1.4-3.

4.10.4.2 Nature and Extent of Groundwater Contamination

Groundwater data used for this analysis include all grab groundwater samples but include only recent monitoring well data (collected from 1999 to more recent). Data collected since January 1999 most accurately reflect current site conditions.

TPH-diesel has been detected at elevated concentrations in groundwater near FOPL segments I1/4/B471, I1/6/B473A&B, and I1/6/B693A&B. Figure 3.19-1 shows the distribution of the TPH compound sample results. TPH-diesel was detected at elevated concentrations in groundwater samples collected adjacent to FOPL segments I1/6/B473A&B and I1/6/B693A&B and in the area to the Strait (near the stormwater pipeline utility corridor) where separate-phase hydrocarbons have been observed (see free-product discussion in Section 4.10.2). TPH-diesel was detected at a maximum concentration of 570,000 µg/L at monitoring well 03W08 (in a groundwater sample collected in July 2002). Historically, separate-phase hydrocarbons have been observed in this well, but the thickness is now limited to a very thin product layer based on observations made in 2003. The TPH-diesel concentration detected in at this well in a sample collected in August 2003 was only 4,300 µg/L, indicating a significant decline in contamination over time. Similar declines in TPH-diesel concentrations and product thickness have been observed in other wells at the site (Figure 3.19-1). TPH-diesel is the most prevalent constituent detected at the site at elevated concentrations.

TPH-motor-oil was detected in 10 of 74 groundwater samples and was detected at a maximum concentration of 8,000 µg/L (IR03GB017 in 1993). The maximum TPH-motor-oil concentration detected in groundwater since 1999 is 6,300 µg/L. TPH-motor-oil contamination is bounded by 64 nondetect sample locations. TPH-gasoline was detected at a maximum concentration of 4,900 µg/L (IR03GB022 in 1993). Six groundwater samples contained elevated TPH-gasoline concentrations. However, only one groundwater sample collected since 2002 contained TPH-gasoline at a concentration greater than 500 µg/L, indicating TPH-gasoline is degrading at the site.

BTEX compounds ethylbenzene, toluene, and xylene were detected in groundwater at the site. Ethylbenzene and toluene were detected in two samples each in 1993, with a maximum concentration of 8 µg/L, but have been nondetect at the site since this time. Xylene is the only BTEX compound detected in groundwater samples collected after 1993. Xylene is also the only BTEX compound detected at concentrations exceeding the Tier 1 ESLs. Xylene concentrations were detected in five of 53 groundwater samples, with a maximum concentration of 53 µg/L at IR03GB022 in 1993. The sample collected from IR03GB017 in 1993 also contained xylene at a concentration exceeding the Tier 1 ESL (19 µg/L). Xylene has only been detected in two samples since 1993 at concentrations of 4 and 0.8 µg/L (Figure 3.1-2). These results are below the Tier 1 ESL of 13 µg/L.

Anthracene, benzo(a)anthracene benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, chrysene, fluoranthene, fluorene, dibenz(a,h)anthracene, pyrene, phenanthrene, and naphthalene have been detected in groundwater samples collected in the vicinity of FOPL segments I1/4/B471,

I1/6/B473A&B, and I1/6/B693A&B at concentrations exceeding Tier 1 ESLs. The analytical results for PAHs detected in samples collected in the vicinity of these FOPL segments are presented in Figure 3.1-3. Areas of elevated contamination are bounded 46 nondetect sample locations.

The PAH and TPH compounds with elevated concentrations (TPH-diesel, TPH-motor-oil, TPH-gasoline, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, chrysene, fluoranthene, fluorene, dibenz(a,h)anthracene, pyrene, phenanthrene, and naphthalene) were evaluated in a Tier 2 risk analysis to determine whether each constituent causes significant human health or ecological risk. The methodology used to perform the Tier 2 risk analysis is presented in Appendix D. The Tier 2 screening levels are presented in Table 1.4-4. The EPC for TPH-diesel is greater than the corresponding Tier 2 screening level. The EPCs for all other COPCs were below the corresponding Tier 2 screening level.

Degradation of Groundwater Assessment. Petroleum hydrocarbons and PAHs have been detected in groundwater samples collected downgradient of FOPL segments I1/4/B471, I1/6/B473A&B, and I1/6/B693A&B at concentrations that exceed the appropriate water quality objective for identifying sources of potential degradation to Mare Island Strait (chronic toxicity level for marine aquatic environments). These elevated concentrations were detected in monitoring wells located approximately 80 feet away from Mare Island Strait, indicating that petroleum hydrocarbons associated with previous releases from these FOPL segments may not degrade or stabilize before migrating to the Strait. Based on the results of the 2002-2003 field investigation, FOPL segment I1/6/B473A&B may remain in the subsurface and, therefore, may serve as a potential source of soil and groundwater contamination at the site. An interim remedial action will be performed at this FOPL segment, as presented in Section 4.10.5. Following interim remedial activities to address this potential source of contamination, a technical and economic evaluation will be performed consistent with RWQCB guidance to identify the most technologically and economically feasible alternative for remediating groundwater at IR03. Remedial alternatives for groundwater at IR03 will be evaluated in a separate document in accordance with Task C.10 of RWQCB Order R2-2002-0105 (RWQCB 2002).

4.10.5 Conclusions and Recommendations for Further Investigative and/or Remedial Action

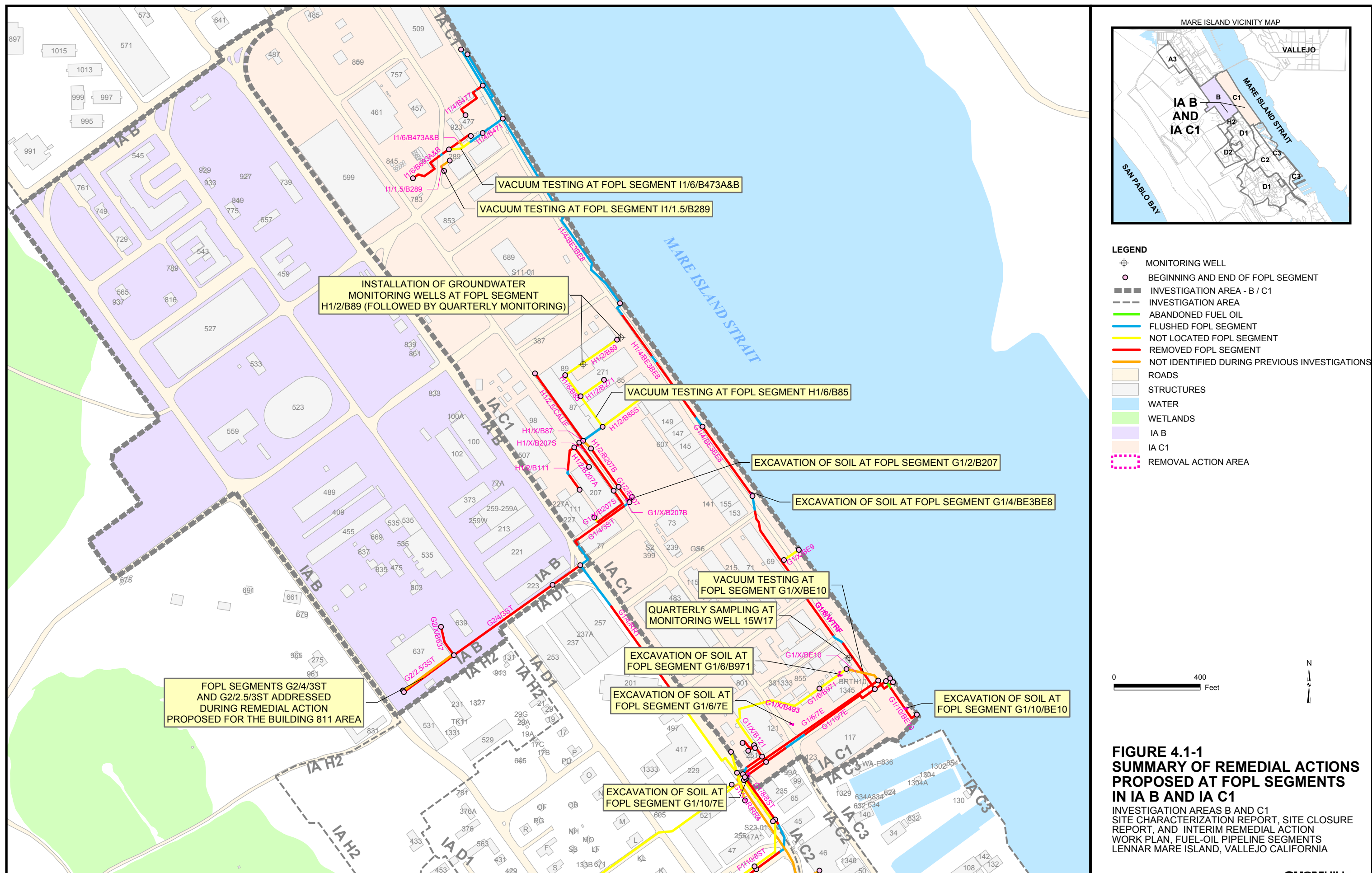
Analytical data and observations made during previous investigations suggest that a release has occurred to soil and groundwater in the vicinity FOPL segments I1/4/B471, I1/6/B473A&B, and I1/6/B693A&B. It is suspected that separate-phase hydrocarbons were previously released from the FOPL and subsequently migrated along the stormwater pipeline utility corridor intersecting at FOPL segment I1/4/B471 (Figure 3.19-1). Separate-phase hydrocarbons have been observed in monitoring wells positioned along the eastern end of the site adjacent to Mare Island Strait. Based on data collected in 2002 and 2003, contaminated groundwater remains at locations adjacent to Mare Island Strait.

A Tier 2 risk analysis was performed in accordance with RWQCB guidance (RWQCB 2003) to evaluate the potential risk from COPCs in soil and groundwater. The Tier 2 screening levels and the methodology for deriving the Tier 2 screening levels are provided in Appendix D. With exception to TPH-diesel in groundwater, all COPCs in soil and

groundwater were detected at concentrations below the corresponding Tier 2 screening levels.

A pipeline suspected of being FOPL segment I1/6/B473&B was located during trenching activities in October 2003. This pipeline is a potential source of soil and groundwater contamination at the site. Consequently, an attempt will be made to test, flush, and cap this pipeline. Up to three trenches will be excavated in the vicinity of this FOPL segment to allow for vacuum testing. The pipelines will be cut in each of the trenches using cold-tapping procedures. Following pipeline draining (if necessary), vacuum tests will be performed. If the pipeline sections successfully hold a vacuum of 5 inches mercury for 30 minutes with less than a 10 percent deviation in the vacuum, the pipelines will be considered to be absent of fractures and will subsequently be flushed and sealed with concrete caps. If a vacuum cannot be maintained, pressure testing and/or video surveying may be performed to isolate the point of fracture. However, further investigative or remedial action will be based on pipeline conditions encountered in the field and will be performed in collaboration with regulatory agencies.

Following interim remedial activities of FOPL segment I1/6/B473A&B, a technical and economic evaluation will be performed consistent with RWQCB guidance to identify the most technologically and economically feasible alternative for remediating groundwater at IR03. Remedial alternatives for groundwater at IR03 will be evaluated in a separate document in accordance with Task C.10 of RWQCB Order R2-2002-0105 (RWQCB 2002). Based on the results of the technical and economic evaluation, this separate document will recommend a final remedial action for groundwater at the site and will identify a schedule for implementation of the recommended remedial alternative. The selected remedial alternative will be implemented in accordance with Task C.11 of the RWQCB Order.



5.0 References

- California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB).
1996. *Supplemental Instructions to State Water Board December 8, 1995, Interim Guidance on Required Cleanup at Low Risk Fuel Sites*. San Francisco Bay Region RWQCB. January 5.
- _____. 2002. Order No. R2-2002-0105. October 16.
- _____. 2003. *Screening for Environmental Concerns at Sites With Contaminated Soil and Groundwater*. San Francisco Bay Region RWQCB. July.
- _____. 2004a. Letter. "Conditional Approval of No Further Action for Pipeline Segments in Draft Fuel Oil Pipeline Site Identification Technical Memorandum, Mare Island, Vallejo, dated November 25, 2002." January 30.
- _____. 2004b. Letter. "Approval of Draft Site Closure Summary Report for FOPL Segments in Investigation Area C2, Mare Island, Vallejo." January 13.
- CH2M HILL. 2001. *Final Quality Assurance Project Plan, Lennar Mare Island, Vallejo, California*. November.
- _____. 2002a. *Draft Fuel-oil Pipeline Site Identification Technical Memorandum, Mare Island, Vallejo, California*. November 25.
- _____. 2002b. *Draft Sampling and Analysis Plan for the Fuel-oil Pipeline, Lennar Mare Island, Vallejo, California*. July.
- _____. 2002c. *Draft Site Investigation Work Plan for Building 811 Area, Investigation Area B*. December 18.
- _____. 2002d. *Request for Closure of Underground Storage Tanks 51, 53 and 55 in Investigation Area C1*. June 10.
- _____. 2002e. *Final Investigation Area C1 Site Identification Technical Memorandum*. May.
- _____. 2002f. *Draft Sampling and Analysis Plan for Investigation Area C1*. January.
- _____. 2003a. *Final Sampling and Analysis Plan for the Fuel-oil Pipeline, Mare Island, Vallejo, California*. September 16.
- _____. 2003b. *Draft Site Closure Summary Report for Fuel-oil Pipeline Segments D1/4/B678N1, D1/4/B678N2, E2/4/B382, E2/2/B390, E2/3/B388, E2/3/B386, and G1/10/8ST in Investigation Area C2, Mare Island, Vallejo, California*. April 30.
- _____. 2003c. *Draft Site Characterization and Removal Action Summary Report for Six Underground Storage Tanks in Investigation Area B*. December 9.
- _____. 2003d. *Draft Site Characterization Report/Interim Remedial Action Work Plan, Investigation Area D1 Fuel-oil Pipeline Segments*. October.

- _____. 2003e. *Final Interim Removal Action Work Plan for Industrial Wastewater Pump Stations 1, 12, 6, IR01, IR19, Building 461, and Building 690.*
- _____. 2003f. *Assessment of the MUN Beneficial Use Designation for the Eastern Early Transfer Parcel, Mare Island, Vallejo, California.*
- _____. 2003g. *IA C1 UST Site Characterization Report, Lennar Mare Island, Vallejo, California.* November.
- _____. 2003h. *Site Closure Summary Report for FOPL Segments G1/6/B829A&B, H1/2/B207B, I1/4/BE3BE8, and I1/4/B477 in Investigation Area C1, Lennar Mare Island, Vallejo, California.* March.
- _____. 2003i. *Request for Closure of Previously Unidentified Cistern 87 in Investigation Area C1.* November 12.
- _____. Pending. *Draft Site Characterization Report and Interim Remedial Action Work Plan for Building 811 Area in Investigation Area B, Lennar Mare Island, Vallejo, California.* March.
- City of Vallejo. 1994. *Mare Island Final Reuse Plan* July.
- Department of Defense, Department of the Navy (DoD). 1995. Letter to Commanding Officer, Engineering Field Activity, West from Douglas R. Ghiselin, commander, Mare Island Naval Shipyard. "Out-of-compliance and Abandoned Underground Storage Tanks." October 30.
- Diblee, T. 1981. *Preliminary Geologic Map of Mare Island Quadrangle, Solano and Contra Costa County, California.* U.S. Geologic Survey Open File Report, 81-0234.
- Ecology and Environment. 1983. *Initial Assessment Study of Naval Shipyard, Mare Island, Vallejo, California.* Prepared for Navy Assessment and Control of Installation Pollutants Department. March.
- IT Corporation (IT). 1992. *Site Characterization Summary for Mare Island Naval Shipyard.* Martin Marietta/IT Corporation, Oak Ridge, Tennessee. January.
- L&W Environmental Services, Inc (L&W). 1988. *Soil and Groundwater Investigation, Building 225, Mare Island, Phase I, Final Report.* February.
- Lennar Mare Island (LMI). 2000. *Preliminary Land Use Plan.* May 23.
- Mare Island Naval Shipyard (MINS). 1990. *Meteorological Records, Years 1984 to 1990.*
- _____. 1996. *Historical Survey of Mare Island Complex, 1994-1995.* Volumes I-IV. February.
- Massachusetts Department of Environmental Protection (MADEP). 2001. *Characterizing Risks posed by Petroleum Contaminated Sites: Implementation of the MADEP VPH/EPH Approach.* Final Draft. Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup and Office of Research and Standards. June.
- Morris, Jeff/CH2M HILL. 2003. Minutes from the Lennar Regulatory Agency Teleconference. November 18.

- Oakshott. 1978. *California's Changing Landscapes – A Guide to the Geology of the State*. McGraw-Hill, Inc.
- PRC Environmental Management, Inc. (PRC). 1991. Fuel Line Leak at Mare Island Shipyard (MINSY): REF: (a) Meeting 10 July 91 LT Newell/WestNAVFACENGCOM (Code 1822LG) Ms. Lisa Grippo. July 11.
- _____. 1995a. *Site Investigation at Buildings 637/811, 633/635a/635b/635c/647, 742 area, 796, and Construction Debris Piles Near Building 505, Summary Report, Volume I and II*. August 2.
- _____. 1995b. *Preliminary Assessment/Site Inspection, Final Summary Report, Nonradiological Sites*. May 19.
- _____. 1995c. *Site Investigation at Berth 10 Draft Final Report*. January.
- _____. 1996a. *Technical Memorandum: Tidal Influence Study, Mare Island, Vallejo, California*. November 20.
- _____. 1996b. *Draft Remedial Investigation Report, Operable Unit 3, Mare Island, California*. December 24.
- _____. 1996c. *Draft Remedial Investigation Report, Operable Unit 3, Mare Island Naval Shipyard, Vallejo, California*. December 24.
- Rice et al. 1995. *Recommendations To Improve the Cleanup Process for California's Leaking Underground Fuel Tanks (LUFTs)*. UCRL-AR-121762. David W. Rice, Brendon P. Dooher, Stephen J. Cullen, Lorne G. Everett, William E. Kastenber, Randolph D. Grose, Miguel A. Marino. Lawrence Livermore National Laboratory. Livermore, California. October 16.
- Richesin & Associates, Inc. and Stearns, Conrad, and Schmidt Consulting Engineers, Inc. (Richesin/SCS). 1987. *Verification Study Report, Mare Island Naval Shipyard, California*. January.
- Supervisor of Shipbuilding, Conversion and Repair, Portsmouth, Virginia, Environmental Detachment (SSPORTS). 1996a. *Basewide Environmental Baseline Survey, Former Mare Island Naval Shipyard, Supplement for Zone 02*. August 08.
- _____. 1996b. *Basewide Environmental Baseline Survey, Former Mare Island Naval Shipyard, Supplement for Zone 03*. May 31.
- _____. 1996c. *Removal Summary Report for Underground Storage Tank Site 829, Former Mare Island Naval Shipyard, Vallejo*. March 12.
- _____. 1996d. *Closure Plan for Underground Storage Tanks 693, Mare Island Naval Shipyard*. September 20.
- _____. 1997. *Interim Technical Report Summary, Installation Restoration Site 03 (IR03) Berths 4 and 5, Mare Island Naval Shipyard*. July 15.
- _____. 1998. *Removal Summary Report for Underground Storage Tank Site 693, Former Mare Island Naval Shipyard, Vallejo*. February 6.

- Tetra Tech EM Inc. (TtEMI). 1998a. *Wastewater Monitoring Industrial Waste Water Treatment Plant Operation Summary Sheets, Years 1990-1994*.
- _____. 1998b. *Meteorological Records, Years 1984 to 1990 and 1992*.
- _____. 1998c. *Daily Precipitation and Maximum Temperature, Years 1970-1995*.
- _____. 1998d. *Site Assessment Report UST Sites A-25, A-58, A-225, A-267, 243/231, 505, 637, 810, and 993-4, Mare Island, California*. Draft. June 12.
- _____. 1998e. *Draft Work Plan Underground Storage Tank, Fuel Pipeline, and Utility Corridor Site Investigation, Mare Island, California*. September 3.
- _____. 2000a. *Offshore Areas Ecological Risk Assessment, Mare Island, Vallejo, California*. Final. March 13.
- _____. 2000b. *Draft Site Assessment Summary Report for Site 829 Mare Island, California*. December 8.
- _____. 2001a. *Onshore Ecological Risk Assessment, Mare Island, Vallejo, California*. Draft Final. January.
- _____. 2001b. *Letter Report for Status of Oil Water Separator 121, Mare Island, California*. March 30.
- _____. 2001c. *Final Letter Report for Status of Berth 10 Fuel Oil Pipeline Investigation Mare Island, California*. April 25.
- Tetra Tech EM Inc. and Morrison Knudson (TtEMI and Knudson). 1999. *Final Work Plan, Fuel Pipeline Locations Site Investigation*. September 11.
- Tetra Tech EM Inc. and Uribe and Associates (TtEMI and U&A). 1998. *November 1997 Phase II Quarterly Groundwater Sampling Report, Mare Island, Vallejo, California*. March 9.
- Tetra Tech EM Inc. and Washington Group International, Inc. (TtEMI and Washington). 2001. Final. *Fuel Pipeline Investigation Status Report for Buildings 85, 207, 257, 386, 388, and 390, Mare Island, California*. March 14. [NOTE: The Navy did not submit this document to the regulatory agencies.]
- United States Department of the Navy (Navy). 1996. *IR03 Product Removal*. April 2.
- _____. 1998. *IR03 Well Monitoring for LNAPL*. September 1.
- Wagner, D.L. and E.J. Bortungo. 1982. *Geologic Map of the Santa Rosa Quadrangle, California*. Scale: 1:250,000. California Division of Mines. Geol. 6 sheets.
- Western Regional Climate Service. 2001. General Climate Summary Information. Martinez Water Plant, California. November 12.
- Weston. 2000. *Environmental Report: Draft Summary Report for Removal of TPH Contaminated Soil at Former UST Sites 243/231 and 637, Former Mare Island Naval Shipyard, Vallejo, California*. April 26.

_____. 2001. *Draft Removal Summary Report for Fuel Oil Pipelines, Former Mare Island Naval Shipyard, Vallejo, California*. February 16.